THE SICKNESS EXPERIENCE OF DIABETICS

by

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S U M M A R Y

The literature on the subject of diabetes prevalence and incidence has been discussed and it was seen that the frequency of diabetes as reported from population surveys varied from one survey to another, according to the diagnostic definitions used in each survey. The frequency of diabetes based on the number of patients attending medical institutions would be affected more by problems of population definition rather than by those of disease definition. However, diabetics attending hospital clinics have been demonstrated to represent the total diabetic population, and that diabetes prevalence in a community as estimated from the number of patients attending hospital clinics is approximately the same as that of known cases obtained from whole-population surveys.

In order to make myself competent to understand all processes taking place in the diabetic clinics I underwent a period of training in the Diabetic and Dietetic Department of Edinburgh Royal Infirmary, and achieved a level of competence which allowed me to conduct the routine clinic's work myself. This prepared me for the present study in which I ascertained that 955 new diabetics were diagnosed and treated in various Edinburgh medical institutions, during the years 1969-1971. The annual incidence of diabetes in Edinburgh was thus estimated to be 0.68 per thousand population. Where the sexes were considered separately the overall incidence is not very different - 0.67 per thousand in men and 0.70 per thousand in women. Age

specific annual incidence rate showed continuous increase with advancing age. Ages contributing most heavily to new cases were those between 60-79 years. The annual incidence rate in these ages for men ranged from 211 to 223 per 100,000, and for women from 190 to 209 per 100,000. As far as the provision of health services to diabetics is concerned, the incidence has been shown to increase successively in each of the three years studied, and can be expected to increase more in the future with the increase in the proportion of elderly in the population.

775 diabetics who attended the Diabetic and Dietetic Department of the Royal Infirmary, Edinburgh, for the first time in the years 1969-1971, were studied in detail. Of these, 249 patients were interviewed at their home personally by the author. These patients were interviewed in order to discuss the effect that diabetes might have on the diabetic's way of life, in terms of his working capacity and limitation of activity; also to test the reliability of the hospital's collected data.

A large proportion of diabetics, because of age and not because of any disability, are economically-inactive. This is mainly because these diabetic men and women are beyond pensionable age.

The association of other diseases with diabetes, such as cardiovascular diseases, cataract, autoimmune diseases and others, was confirmed, but much of it was shown to be due to the higher ages in which diabetes is found, the better medical care that diabetic patients seem to receive, and the fact that diabetes is more likely to be diagnosed in such a patient than in an elderly person without any disorder. The association of one or more disease conditions with diabetes among patients who died within a period of four years after diagnosis, compared with that among survivors, was statistically significant. However, the majority of patients (79 out of 96) who died were above the age of 60 years at time of diagnosis. Cardiovascular diseases were the cause of death in 54 out of the 96 patients.

Restricted activity, which is the most inclusive term used to describe disability as experienced by any one person, showed that in the young diabetics it was mainly due to, or associated with diabetes itself, while in elderly patients it was closely associated with their advanced age.

Attendances at the diabetic clinic, as well as hospital admissions and length of stay, showed once more the distinction between diabetics according to their age. For all ages diabetics were shown to have a longer period of hospitalization than the general population. However, little of it was attributed to diabetes.

The hospital cost per diabetic per year was seen to be the most expensive of all health services used by diabetics, and it is suggested that to make the best of the available resources, and to serve diabetics more adequately, a closer liaison should be established between the hospital clinic and other medical and social services outside the hospital.

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C O N T E N T S

INTRODUCTION

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With the advance of medical science and the application of preventive measures to communicable diseases, it is no longer customary to restrict the term epidemic to diseases known to be infectious. Carcinoma of the lung and ischaemic heart disease are clearly epidemic nowadays in western societies. This also applies to diabetes mellitus. E.P.Joslin, earlier this century, found in his home town of Massachusetts, that six out of seven people - heads of families - who were living in three houses side by side, succumbed to diabetes. He pointed out that although the cause of death in all the six people was the single cause of diabetes, no one spoke of an epidemic. This is in contrast to what the reactions of the public health authorities would have been had the cause of death been a disease like scarlet fever, typhoid fever, or tuberculosis: "Because the disease was diabetes and because the deaths occurred over a considerable interval of time, the fatalities passed unnoticed. Even the insurance companies failed to grasp their significance and yet probably no group of individuals in the community carried _per capita_ a higher amount of insurance than did these six diabetics" (Joslin, 1959a). In contrast to the high frequency of diabetes today, E.P.Joslin, searching the medical records in Massachusetts General Hospital for the period 1824-1898, found only 172 cases of diabetes mellitus. (Fitz and Joslin, 1955).

Diabetes mellitus as a cause of death among the population, has advanced in position, and in recent years it occupied a place among the top causes of death in western societies. In the United States it has done so, from being in the twenty-seventh position in 1900 to the eighth position in 1956. From the Metropolitan Life Insurance Company's industrial experience in 1956, it has already passed pneumonia and tuberculosis, and ranks sixth as a cause of death, or, excluding deaths from violence, fifth, and grouping under vascular disease deaths from those of the heart, central nervous system and kidneys, to third place. In the Metropolitan Life Insurance grouping, vascular disease and cancer alone would exceed it (Joslin & Krall, 1959).

Since Joslin's earlier days many epidemiological studies on diabetes have been done. Most of these were aiming at early detection and surveillance for the diabetics, as well as to determine the prevalence of the disease. Much more research has been done on the biochemical and endocrinological aspect of diabetes mellitus, so much so that it is now clear, especially with the increasing interest in diabetes and related problems, a great deal of epidemiological work is needed to demonstrate the value, and to translate correctly, the findings of this biological research into medical application. Professor W.J.H. Butterfield (1969) illustrated this need well: "Epidemiological work and investigation on diabetes give perspective which is usually lacking in the wards, clinic, laboratories, consulting rooms, offices..... It is probably unfortunate that we doctors have followed our calling to heal as assiduously since spending so much time working on possible endocrinological causes of diabetes or unravelling the biochemistry of insulin and its metabolic effects, and have only recently begun to pay proper attention to the epidemiology of the disease we aim to cure and, if possible, prevent."

Some epidemiological studies have investigated the question of longevity and survival among diabetics. The effect of various medical and social variables have been studied in relation to the duration of life of diabetics. These studies have observed the development of diabetes complications and other disabilities in patients with diabetes duration of some 10-20 years or more.

The effect of the presence of other diseases commonly associated with diabetes as well as the effect of socio-demographic factors on the quality of the diabetic's life, have rarely been studied before.

With this in mind we constructed this study to describe the various medical, social and demographic factors affecting the life of diabetics in whom diabetes has recently been discovered. The presence of diabetes complications and the association of other diseases among diabetics, are studied at the time of the discovery of diabetes to try to avoid the effect of diabetes duration on the presence of such diseases, and to obtain a clearer picture of any existing association between diabetes and other chronic diseases. Also, to describe the effect of the diabetic state in its early days on the life of diabetics, and in relation to their social and demographic characteristics.

Thus the main objective is to study the newly diagnosed diabetics to ascertain the annual incidence of the disease;

the association of other diseases with diabetes, and the presence of diabetes complication at time of the discovery of the disease; and the mortality trend among the newly diagnosed diabetics. The effect of the diabetic state on the life of diabetics in terms of their working capacity, general health, and well-being, will be examined and the implication of diabetics on the health services would be discussed to try to provide information usually required for the evaluation of community health and planning of medical care for the diabetics.

In order to do this, the survey was designed with a view to obtain information regarding diabetes incidence in Edinburgh, and to study morbidity and mortality among newly diagnosed diabetics. The study is based mainly on those patients who had attended the diabetic clinic at the Royal Infirmary, Edinburgh, for diagnosis and treatment of diabetes during the years 1969, 1970 and 1971. Only those patients residing in the City of Edinburgh were considered in the study (1116 patients), and of those, 776 were diabetics. The remaining 340 non-diabetics were included in order to study the causes of their referral to the clinic, and the results of the glucose tolerance tests performed on them.

To measure as accurately as possible the annual incidence of the disease in Edinburgh, all general hospitals, the Royal Hospital for Sick Children, and long-stay geriatric hospitals were contacted to obtain information about diabetic patients diagnosed in 1969, 1970, and 1971. As a result, 277 newly diagnosed cases were found attending other hospitals. Information regarding the number of patients not referred from general practitioners was also ascertained.

To complete information collected on the diabetic patients attending the Royal infirmary clinic, and to measure the reliability of data collected from the hospital records, it was decided to contact and to interview all patients who attended the diabetic clinic in the year 1971. Of the 282 patients who attended the clinic in 1971, 247 were interviewed at their homes, personally by the author. Two other patients were contacted by letter. The remaining 33 patients were not interviewed, and the reason for this was the death of 29 patients, and for other reasons given later in the case of the other 4 patients.

Until the end of the observation period in 31.12.72, 96 patients out of 776 had died. The Registrar General's Office in Edinburgh was contacted, and the death certificates of all 96 patients were obtained in order to study the causes of death and other mortality trends among them.

This thesis will discuss in detail the frequency of diabetes as well as the social and medical characteristics of diabetics to assess the effect of this disease on their life, and on the health service.

P A R T I

MORBIDITY IN DIABETIC PATIENTS

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Prevalence of Diabetes Mellitus

Experience among different communities

Diabetes mellitus is a universal disease (Joslin & Krall, 1959 ; Eutmacher & Marks, 1965). It occurs in all parts of the world and there is no race in which diabetes does not exist. Joslin had concluded from his survey in the State of Arizona in 1937 that there is no doubt about the universality of diabetes, and that it existed in males, females, white and Indians. The Arizona survey supported the belief that the reported incidence of diabetes is highest where: the average age is oldest; women predominate; obesity is more frequent; medical supervision is closest; and deaths are most accurately reported. Eutmacher and Marks in 1964, when reviewing the world-wide surveys on diabetes, suggested a figure of 30 million as a number for diabetes in the world, assuming a prevalence rate of 1 per cent is applied. Obviously no single figure is applicable to a total of every country because of the wide variations in different localities with respect to age, composition, occupational distribution, standard of living and nutritional states and other pertinent factors.

In the United States of America, McDonald (1968), reported an estimated prevalence rate of 14.5 per 1000 population for all ages of diagnosed diabetics. In this country, the most comprehensive study, carried out in Birmingham in 1962 (Working

Party of the College of General Practitioners, 1962), reported a prevalence rate of 6.4 of known diabetics per 1000 population and previously undiscovered cases of 6.9 per 1000. There is no evidence that the prevalence of diabetes differs appreciably in most European countries from that of Britain (Brandt et al, 1964; Munke, 1964; Jorde, 1962; and Schliach, 1969). In Canada, the two Community Surveys done in 1951 and 1953, reported 7.5 per 1000 as known cases, as against nearly 5 new diabetics per 1000 (Kenny et al, 1951; Kenny & Chute, 1953).

The results of the surveys done in Asia and Australasia show that the prevalence varies from 8 per 1000 to about 100 per 1000 (Patel, 1969). This reflects the wide range of variability due to different diagnostic criteria used, and mainly to type of population studied in each individual survey. For example, women predominated in results of surveys done on a population basis, while male diabetics predominated in surveys based on hospital records. This not only explains the sex differences in the reported results, but obviously affects the value of the reported prevalence as a whole.

The diagnostic criteria used in surveys affect the reported prevalence which is demonstrated in the example from Malta. Meample in 1965, reported a rate of "diabetes" of 20 per cent in the general population of Malta. This figure was reached by using a rather generous criteria for the diagnosis (glucose tolerance curve with fasting, or 2-hour blood sugar over 100 mgm per 100 ml, and a peak value of over 150 mgm per 100 ml).

The reported prevalence will also vary although the same criteria were used, apparently due to intrinsic racial differences in environment. A team of investigators (West and Kalbfleisch, 1963, 1966; West, et al, 1966), using the same methods of glucose tolerance testing, reported the prevalence of diabetes in nine countries throughout the world (Asia, South, Central and North America). Within the Americas the prevalence per 1000 of population varied from 73 in Venezuela to 22 in El Salvador. Using the same level of 150 mgm per 100 ml (after 2 hours of 1 gm/kgm body weight of oral glucose) as the criteria, the hyperglycaemia rate was lower in the Asian country of Malaya and still lower in East Pakistan.

The ethnic or racial factors also affect the reported prevalence within the same country. In the study done in 1961-62 in Trinidad, Pooking, et al, (1962), had shown that the East Indian population of Trinidad experienced a diabetes prevalence rate of 23.7 per 1000, but the Negro population of Trinidad showed a rate of only 14.4 diabetics per 1000.

Ethnic variation in prevalence of diabetes was also demonstrated by the intensive studies of several research groups on the American Indian in the United States. Diabetes among Athabaskan Indians is rare (Mouratoff, Carroll and Scott, 1969), while among Pima Indians its prevalence in the whole population exceeds 20 per cent (Miller, Bennett and Burh, 1968), and in men over the age of 35, it exceeds 40 per cent. There was significantly elevated post-prandial blood sugar in 30 per cent of the subjects aged 30 years and over. In 800 Pimas, who had not been previously tested, a standard blood glucose and urine test revealed that 31 per cent of those above the age of 10 years were diabetics (Miller, et al, 1965). The Navajo Indians, now the largest Indian tribe in the United States, have a low prevalence rate of about 1 per cent, compared with the rate among the Pimas of more than 20 per cent. The difference was explained by McDonald (1969), and by Joslin (1959) before him, as being due to the historical, environmental, and cultural pattern of these two tribes. In contrast to the nomadic (the Navajos and Apaches) who had a scarcity of food, the Pimas have led a stable well-fed existence, and were more opulent, and hired others to work for them.

Rimoin (1969) has compared some of the metabolic features of Navajo with those of another distinct population, the Pennsylvania Amish. Diabetes among the Amish is of the typical European variety, with both juvenile and maturity forms, and showed the usual diabetes complications. Oral glucose tolerance tests were performed and blood glucose and plasma-immunoreactive-insulin (I.R.I.) levels were measured. In people with normal glucose tolerance, the maximal I.R.I. response was three times greater in Navajo than Amish, a difference which could not be accounted for by differences in the prevalence of obesity. Amish diabetic patients secreted large amounts of insulin compared with Amish controls, while Navajo diabetic patients secreted small amounts compared with Navajo controls. Rimoin suggested that the metabolic and clinical differences in diabetes observed in these two ethnic groups, as in others, are best ascribed to genetic heterogeneity, and that this hypothesis is supported by the fact that at least 16 distinct genetic disorders, including Werner's Syndrome (Field and Loube, 1960), Turner's Syndrome (Nielson, Johanson and Yde, 1969), and Alström's Syndrome (Alström, et al, 1959) are associated with impaired glucose tolerance.

Food consumption and dietary habits affect the prevalence of diabetes. In contrast to the American Indians, few diabetics have been found among the Alaskan Eskimos, whose diet is high in protein and fat, but low in carbohydrate. In a population of 16,000 in Alaska, only 3 cases of diabetes were known, and a survey of 1200 Eskimos (by post-prandial blood sugar measurement) revealed no case of diabetes (Scott and Griffiths, 1957). Mouratoff, Carroll and Scott (1967) reported that among 2167 Eskimos in 10 villages of Alaska, only 8 diabetics are known and only 1 case was discovered in the survey.

Another good example of the effect of food availability on the prevalence of diabetes is that which occurred during and after the last world war (Office of Health Economics, 1964a).

A compilation of diabetics in Great Britain, certified for special food rationing in December 1947, yielded a rate of 2.3 per 1000, and if compared with the recent figure of the Birmingham survey (1962) of 13 per 1000, shows that rationing of food might have been one of the causes for the reported low frequency of the disease during the post-war period.

In general there are differences in the reported prevalence from one country to another, and these differences in prevalence are mainly due to the type of population studied, method used

Table 1 : Prevalence of diabetes in the population: main findings of ten surveys

	Total population	Site	Age Limit	Per cent tested	Test	Results
H.L.C.Wilkerson and L.P.Krall, 1947 J.A.M.A. 135, 209	4,983	Oxford, Mass (small town)	None	17	Urine and blood about 1 hour p.c.	D.M. in 2 per cent of whom half known to be diabetic: most over 45
(a) Wilkerson and Krall, 1953, J.A.M.A.152,1322 (b) (with F.K.Butler) ibid. 1959,169,910		Oxford, Mass. (small town)			Urine and blood about 1 hour p.c.	7/70 diabetics found in 1947 study now non-diabetic. 14 per cent of 'suspects' now diabetic. Rate of development of D.M. in 'suspects' eight times normal
A.J.Kenny, A.L.Chute and C.H.Best, 1951, Canad.Med.Assn.J. 65,233	5,143	Newmarket, Ontario (small town)	Mainly over 6	81	Urine and blood about 1 hour p.c.	D.M.in 1.2 per cent (women more than men) of whom 2/3rd already known. Over half aged 60+. Most discovered cases had symptoms
A.J.Kenny and A.L.Chute, 1953 Diabetes, 2, 187	4,362 5,824	South Porcupine Ontario Hawkesbury, Ontario (Small towns)	Mainly over 6	71 61	Urine and blood about 1 hour p.c.	Among women aged 50+ and men aged 60+. 6 per cent had D.M.
I.H.Redhead, 1960, B.M.J., 1, 695	1,991	Newcastle-on-Tyne (Large town)	All ages	Constructed sample of a general practice	Urine 1 hour p.c. If + G:T.T. or B.S.2 hours p.c.	Glycosuria in 5 per cent of clinistix, 2.5 per cent by clinitest, D.M.known in 0.5 per cent, discovered in 0.5 per cent, symptoms rare.
J.B.Walker and D.Kerridge, 1961, Diabetes in an English Community, Leicester University Press	5,406	Ibstock, Leics. (Small town)	Over 5	81	Urine 1 hour p.c. (+ extra glucose). If + G.T.T.	D.M. found in 1.3 per cent (half already known), nearly all aged 45+. Diabetics tended to be obese and of high parity
College of General Practitioners, 1962, B.M.J. 1, 1497	19,412	Birmingham (part of a large town)	Over 5	96	Urine 1 hour p.c. If + G.T.T.	D.M. in 1.3 per cent mostly aged 50+. Lag storage curve in 0.5 per cent. Other abnormalities of G.T.T. in 0.4 per cent. Renal glycosuria 0.3 per cent. F.H. + in twice as many discovered cases as in controls
J.Harkness, 1962 B.M.J. 1, 1504	6,132	Halstead, Essex (small town)	All ages		Urine 1 hour p.c. If + G.T.T. usually	D.M. in 1.2 per cent; equal sex incidence
Forfar, 1963 Lancet 2, 186	10,758	Forfar, Angus	All ages	85	Urine 2 hours p.c. If + G.T.T.	D.M. discovered in 0.7 per cent; symptoms rare. Lag storage curve 0.6 per cent; renal glycosuria 1.5 per cent. Both commoner in men.
W.J.H.Butterfield, 1964, Proc.Roy.Soc. Med., 57,196	38,400	Bedford (county town)	Over 21	67	Urine 1 hour p.c. If + G.T.T. (G.T.T.also done on random sample of population)	Glycosuria in 4 per cent (men 6 per cent, women 2.5 per cent), commoner in later life. D.M. discovered in 1 per cent (known cases excluded). G.T.T. 2 hours B.S. > 120 in about half of elderly.
A.Munke 1964 Acta Medica Scand. 176, 169	122,476	County of Blekinge, Sweden	Over 10	80	Urine 2-4 hours p.c. If + F.B.S. or G.T.T.	Glycosuria in 1.6 per cent. D.M. known in 1.2 per cent, discovered in 0.4 per cent; in those aged 66+ D.M. in 4 per cent

Techniques and definitions vary. B.S. over 120 mg/100 ml 2 hours after 50 g glucose commonest criterion of D.M.

Source: Clinical D.M. and its Biochemical Basis, W.G.Oakley, D.A.Pyke, K.W.Taylor (1968), p.195
Blackwells Scientific Publications, Oxford and Edinburgh.

for testing the population, and to the diagnostic criteria set as standard of abnormality. Besides these factors the difference may be caused by intrinsic racial differences or differences in environment among various ethnic groups. Examples of the effect of environment are food consumption, fertility, occupation, longevity, activity, genetics, culture, and especially attitudes towards obesity and quantity and quality of medical care.

All these factors obviously affect the prevalence of diabetes, but it is clear that the disease is known all over the world, and as the standard of living of mankind becomes better there is more chance of diabetes prevailing, for two main reasons. Firstly, because of increased longevity, and secondly, because of the increased prevalence of obesity.

Factors influencing the trend in the reported prevalence of diabetes

Although not completely comparable, the surveys done on whole population bases give an estimate of the magnitude of the diabetic problems among different communities. Many such surveys have been done. The methods and results of ten of them are shown in Table 1. Most of these surveys have shown that there are about as many unknown diabetics as known cases. Wilkerson and Krall (1947) started the work in Oxford, Massachusetts in 1946 and 1947, and their methods have set a pattern for many later surveys. They were interested in measuring the prevalence of diabetes to ascertain its magnitude, especially after the warning given by Spiegelman and Marks (1946), which suggested that there will be an increase of 74 per cent in the diabetic population by the year 1985. This is compared with an increase of only 22 per cent in the general population, apparently due to population ageing and lengthening of the diabetic life. Wilkerson and Krall aimed to test the whole population (4,983) of Oxford (a typical American town), to determine accurately enough the prevalence of the disease among the general population. It was possible to test a total of 3,516 (70.6 per cent) of the population. The study was based, beside history taking, on urine, blood sugar, and glucose tolerance tests. The result of that important, simple and basic survey was that a total of 70 cases of diabetes mellitus were found; 40 of these cases were already known, and 30 were discovered during the study. This gave a prevalence of 2.0 per cent of those tested.

For the entire population of 4,983, the prevalence of diabetes in Oxford was 1.4 per cent (0.8 per cent old, and 0.6 per cent new cases). Projecting this figure to the remaining 1467 untested persons, the prevalence of diabetes in Oxford would be 1.7 per cent. According to this, the authors suggested that the prevalence in the whole of U.S.A. is higher than that hitherto reported, and that diabetes is much more prevalent than is commonly supposed with large numbers of unrecognised cases of the disease in each community. Among the 70 diabetic patients there were 31

Table 2: Distribution of categories in the constructed control group*

Category	Number			Per cent
	Men	Women	Total	
"Diabetic" abnormality				
Florid	-	1	1	(0.3)
G.T.T.	14	12	26	7.5
Lag storage	27	25	52	15.1
Renal glycosuria	2	-	2	(0.6)
Miscellaneous abnormality				
A (high fasting)	5	9	14	4.0
B (hump curve)	4	6	10	2.9
C (high 2-hour)	11	28	39	11.3
Unclassifiable	3	7	10	2.9
Normal	96	95	191	55.4
Total	162	183	345	100

Figures in parentheses are based on small numbers.

Source: Working Party, Coll. Gen.Pract. (1963) Brit.med.J. 2, 656

* Values for capillary blood in mgm/100 ml.

Florid diabetes:	Fasting capillary blood sugar	> 130
	1-hour " " "	> 180
	2-hour " " "	> 120
G.T.T. diabetes	Fasting " " "	< 130
	1-hour " " "	> 180
	2-hour " " "	> 120

Lag storage curves: level over 180 at $\frac{1}{2}$ or 1 hour
fasting level under 110
$1\frac{1}{2}$ hour level under 160
2 hour level under 120

Renal glycosuria: Glycosuria found by "clinitest", confirmed as true glucose by clinistix, no blood glucose being above the normal values.

"Miscellaneous" abnormalities:

Group A: Fasting > 110, 2 hour < 120
Group B: $1\frac{1}{2}$ hour > 160, $\frac{1}{2}$ hour or 1 hour or both > 180
Fasting < 110
2 hour < 120
Group C: 2 hour > 120, fasting and 1 hour values were normal.

Normal - No glycosuria using clinitest, although enzyme test might have been positive, all blood values normal - that is below 110 fasting; 180 at $\frac{1}{2}$ hour; 100 at 1 hour; 160 at $1\frac{1}{2}$ hour; 120 at 2 hour.
Unclassifiable - Results not conforming to any of the above categories.

men and 39 women; the median age of the known diabetics was 59.5 years and that of the new patients 55 years.

Since the Oxford study there have been many similar studies throughout the world. Most of these have been based on the testing of a post-prandial urine sample for the presence of glycosuria, people with positive urine tests being tested later with oral glucose tolerance test. In general the prevalence of known diabetes was found to be approximately 0.75 per cent, and for each known case a new case was discovered. The overall prevalence of diabetes, defined as abnormal glucose tolerance, is between 1 and 1.5 per cent of the population. But the results of both the Birmingham (1962) and Bedford (1964) studies suggest that this estimate may be far too low. The working party of the Royal College of General Practitioners (1963), studying diabetes prevalence in Birmingham, took a sample of those persons who had no sugar in their urine during the original survey in 1962. This "control" group of 345 persons were similar in age and sex distribution to the survey population and were investigated by the glucose tolerance test in the same manner. The result was a surprise in that there was one patient with "florid" diabetes, and 26 of "glucose tolerance test" diabetes, indicating abnormal glucose tolerance in 7.8 per cent of the control group. Table 2 shows the number and percentage of the various categories. Only 55.4 per cent of those tested were definitely normal and 18.2 per cent having miscellaneous abnormalities, a deviation from the normal, but this deviation was mostly of no pathological significance.

Table 3 : The changing prevalence of diabetes mellitus

ERA	DETECTION	Treated cases			Untreated cases		Total Prevalence
		with symptoms severe	mild	none	With symptoms	Without symptoms	
Before biochemistry	Clinical	0.1%	?	?	?	?	0.1%
1900-46	Clinical + biochemistry	0.1%	0.5%	0.1%	?	?	0.7%
1947-61	Clinical + biochemistry + urine analysis surveys (Wilkinson & Krall)	0.1%	0.5%	0.1%	0.25%	0.45%	1.4%
1962 -	Clinical + biochemistry + glucose tolerance test (Bedford survey)	0.1%	0.5%	0.1%	Up to 3%	up to 9%	up to 12%

Source: Proc.Roy.Society of Med. (1964) Vol. 57, 196

The widespread intolerance of glucose which was not discovered by urine test, has been explained by the fact that post-prandial glycosuria does not show if the size of the meal is too small, and the height of the renal threshold is often grossly elevated in elderly persons, as these patients showed an abnormal rise in blood sugar, and most of them showed glycosuria after an oral dose of 50 gm of glucose.

The Bedford study also estimated a high prevalence of diabetes. In this study (Butterfield, 1964) glucose tolerance tests were performed on a stratified group of "non-glycosuric" subjects aged 20 years and over. The results were: 30 per cent had glycosuria after the glucose load of 50 gm, and 90 out of 570 people (17 per cent) tested had abnormal glucose tolerance tests. On the basis of these findings the author calculated that the prevalence of diabetes in Britain as a whole was approximately 12-14 per cent. He explained this high prevalence and the change of prevalence since the beginning of this century as being mainly due to change of method of detection (Table 3).

Before biochemistry, when diabetes was detected by testing urine, the prevalence was 0.1 per cent. Pre-World War Two, the figure was 0.7 per cent. Then, using urine testing for glycosuria as a method of case finding, Wilkerson and Krall in 1947, showed that for every known diabetic there is another unknown case in the community, and the prevalence was raised to 1.4 per cent. With the introduction of glucose tolerance testing on a mass scale, for example, the Bedford study, another large increase in overall prevalence had occurred, and it is estimated as being 12 per cent.

Butterfield explained that this increase in prevalence was due to better methods of detection, but he also pointed out that this prevalence was reached by using a low criterion for the suspicion of diagnosis, "120 mgm per 100 mls ... 2 hours after/ administration of 50 gm of oral glucose."

There is also an important third factor which undoubtedly had influenced the increasing prevalence of diabetes, and that is, the ageing of the population. Comparing this situation at the present time with the situation earlier this century, it is clear that due to better environmental conditions, people live much longer now than they used to do before. More and more older persons are living at any given time. The glucose tolerance test is inclined to deviate from "normal" in the case of elderly people more than in the case of the young. The increased prevalence is thus partly due to the ageing of the population.

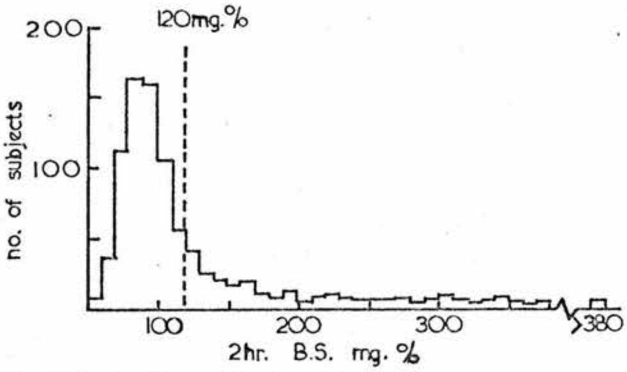
The effect of diagnostic criteria on the reported prevalence

Because there is no sharp dividing line between the diabetic and the normal, the diagnostic criteria used in surveys are arbitrary and differed from one survey to another, with the unfortunate outcome that the results of these surveys cannot be compared with certainty.

The diagnostic criteria laid down by the World Health Organisation Expert Committee in 1965, states that two hours after a glucose load of 50 gm, a capillary blood sugar above 140 mgm per 100 ml in persons under 45 years of age signifies

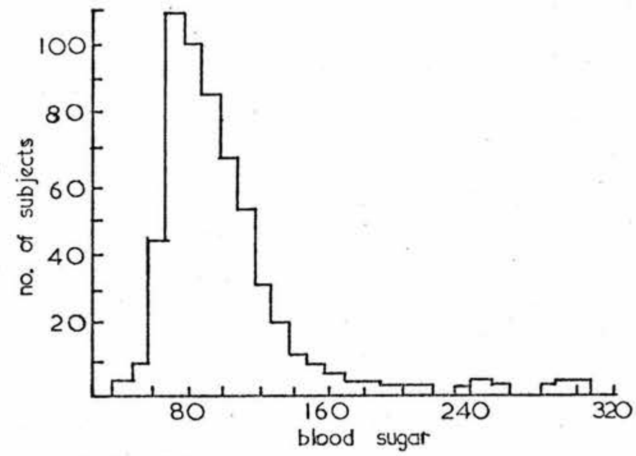
Figure 1.

(a)



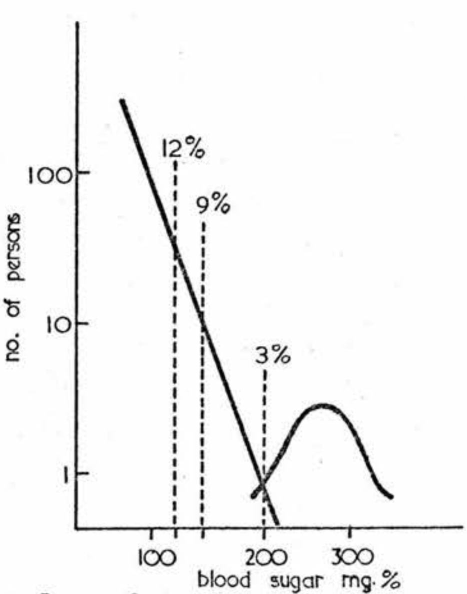
-hr. blood sugar in glycosurics.

(b)



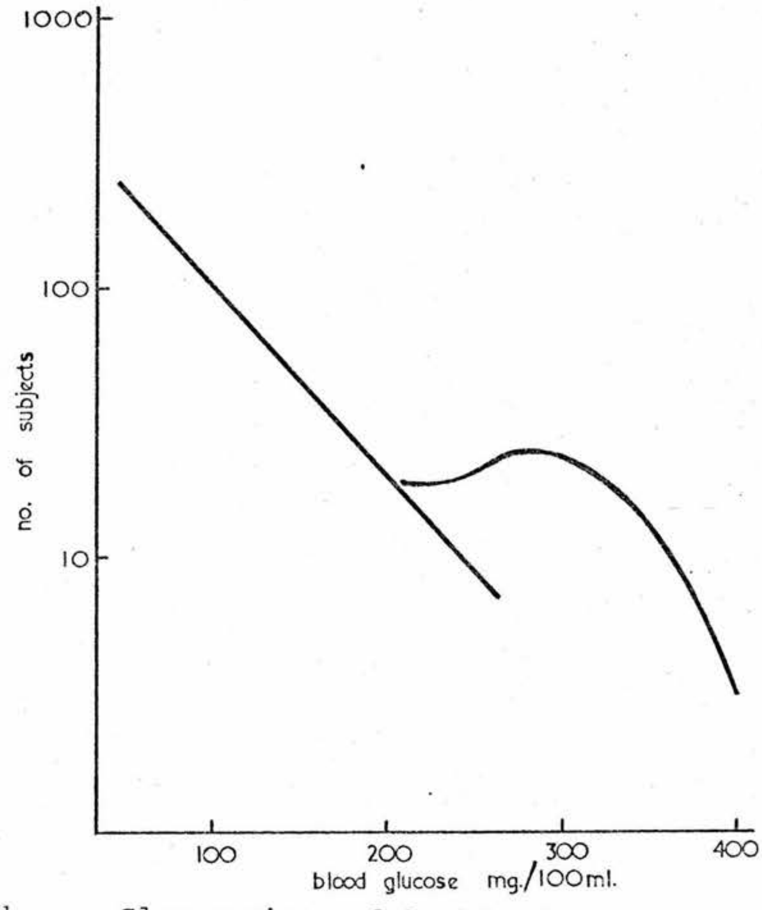
2-hr blood sugar in random sample

(c)



andom sample - 2-hr blood sugar plotted
gainst the log. of the number of persons,
owing? - 2 population and percent
lults above 3 arbitrary levels.

(d)



Glycosurics - 2-hr blood sugar plotted
against the log. of the number of
persons.

EDFORD STUDY: Source: a,b, & c: Proc. sixth Int. Diab. Congress, (1969) pp.
54-55, Excerpta Medica, Amsterdam.

ource d: Diabetes Mellitus, University of Edinburgh.
fizer Medical Monograph 1 (1966), p. 151. University press, Edinburgh.

diabetes, and that a level below 120 mgm per 100 ml is normal. With this information it is hoped that a more unified method of criteria for diagnosis will be used.

In the Bedford study, the blood glucose value of 120 mgm per 100 ml of capillary blood, two hours after 50 gm glucose by mouth, as an indication of abnormality, showed a very high prevalence of hyperglycaemia, especially among the aglycosuric population tested. Two samples of population were tested, one of 937 persons who were not recognised diabetics, but had post-prandial glycosuria (glycosuric), and the other sample constituting 570 persons chosen at random.

Section a and b of Fig. 1 shows the distribution curve for 2 hour blood sugar level in the "glycosuric" and in the sandom sample respectively. By replotting the distribution curve on a logarithmic scale, section c for the random sample and section d for the glycosuric, it was evident that the prevalence of diabetes as detected by oral glucose tolerance testing varies with the level selected for the diagnosis. Section c shows that the prevalence is 12 per cent among adults in the British town of Bedford, if the level of 120 mgm per 100 ml was taken; about 9 per cent if the level of 140 mgm per 100 ml if W.H.O. recommendation was taken; and 3 per cent if the level of 200 mgm per 100 ml was taken.

Butterfield commented that it is clear that 2 hour capillary blood sugar of 200 mgm per 100 ml is the proper discriminatory level at which there is a 50-50 chance of diabetes or physiological hyperglycaemia. At a level of over 200 mgm per 100 ml, the chance is in favour of a diagnosis of diabetes, below 200 mgm per 100 ml the chance is in favour of physiological hyperglycaemia.

The distribution of the blood sugar was skewed, but essentially a continuous one. This supports the evidence that there is no real "cut-off" level and no real validity in segregating diabetics, at a level higher than 120 mgm per 100 ml, and normals with a lower level than 120 mgm per 100 ml. This suggests that the glucose tolerance curve shows no evidence of bimodality. Unimodality of the glucose tolerance distribution was anticipated by Doll in 1959, and later demonstrated by Gordon in 1964, and Hayner et al in 1965.

Unimodality of the glucose tolerance curve suggests that there is no clearly defined line between diabetes and the normal. Consequently it will be necessary to draw a somewhat "arbitrary" end point and define all the values below this figure as normal, and all those above it as diabetic. As in the study of blood pressure (Pickering, 1961), all grades may be found between the most common (normal) and the grossly disordered. These findings agree with the multifactorial determination of carbohydrate tolerance, and accordingly multiple genetic and environmental factors might be expected jointly to determine an individual's carbohydrate tolerance. While this possibility is explored one must remember the prudent reminder by Steinberg (1964) that a lack of biomodality in a distribution does not prove multifactorial determination.

For the purpose of setting criteria of diagnosis it is clear that there is still no definite point at which to segregate the normal from the abnormal on the glucose tolerance curve. The glucose tolerance test, even under fairly standard conditions, gives variable results within individuals, "not good reproducibility" (McDonald, Fisher & Burnham, 1965). And it has been shown by Jarrett and Keen (1970), that the glucose tolerance curve has considerable diurnal variation.

Beside the effect, on the reported prevalence, of changing the diagnostic criteria, there are factors connected with their application in any given survey, thus affecting the reported prevalence. Examples are the reliability and efficiency of the diagnostic test.

Reliability of the test means the extent to which the results of the test may be reproduced by a laboratory technician of average training. This in turn depends on the availability of laboratory resources, number of population tested, and number and quality of training of the personnel conducting the test.

The efficiency of the test is the frequency of confirmation of the test by accepted diagnostic procedure at a given level of reliability. Efficiency of the test is measured in terms of sensitivity and specificity.

Sensitivity is defined as the ability of the test to classify as positive those who have the condition or disease being screened in an apparently well population. It is expressed as the percentage screening positive of the total true previously unknown cases of the disease.

Specificity is defined as the ability of the test to classify

Table 4 : Individual blood-sugar criteria for diabetes mellitus, Forfar Study, 1963

	Criterion	Positive by criterion	Known diabetics detected	Known diabetics missed	False* positive	Technicol faulures	Sensit-ivity	Specif-icity
1.	Fasting B.S.120 mgm(or more) per 100ml	42	21	13	8(13)	4	62%	97%
2.	2hrs.B.S. 140 mgm (or more	35	32	2	1(2)	15	94%	99%
3.	2hrs.B.S. 130 mgm (or more	40	33	1	3(4)	15	97%	99%
4.	$2\frac{1}{2}$hr.B.S. 120 mgm. (or more)	28	24	10	0(4)	18	71%	100%

* The number of positives by the criterion associated with unclassifiable glucose-tolerance tests is given in brackets in the false positive column.

$$\text{Sensitivity} = \frac{\text{Known diabetics detected by criterion} \times 100}{\text{Total known diabetics}}$$

$$\text{Specificity} = \frac{\text{Negative non-diabetics} \times 100}{\text{Total non-diabetics}}$$

Source: Stewart & Robertson (1963) Lancet, 2, 185

* In Forfar Community Survey, all individuals who had Clinistix-positive glycosuria substantiated by Clinitest test were asked to have a glucose tolerance test. This consisted of a fasting blood-sugar followed by 50 grams of glucose orally and then half-hourly capillary blood-sugar specimens to a total of five. The test was regarded as normal if:

(a) The fasting blood-sugar was less than 120 mgm. per 100 ml.

(b) The peak value was less than 180 mgm. per 100 ml.

(c) The 2 hour level was less than 120 mgm. per 100 ml.

as negative those who do not have the condition or disease for which they are being screened. It is expressed as the percentage screening negative of those who do not have the disease in the group being screened.

Although the main purpose of applying a screening test is to discover undiagnosed cases of diabetes, the whole-population surveys applied the screening test to the whole population to determine the frequency of the disease as well as to discover the unknown diabetics. The effect of applying such tests, in the population studies, on the prevalence, would be best investigated by studying the sensitivity and specificity of screening tests.

A variety of screening tests have been advocated to be applied in the case of diabetes (Wilkerson et al, 1955; Remein & Wilkerson, 1961). The general rule in the whole-population surveys has been to follow a positive screening test result with a glucose tolerance test. In Forfar Community Survey (1962), this usual sequence was adopted.* Stewart and Robertson reported that the test selected to follow the substantiation of glycosuria in a person should be a blood sugar measurement made two hours after 50 gm of glucose taken by mouth.

Table 4 shows the sensitivity and specificity of individual blood sugar criteria for diabetes mellitus used in Forfar diabetic survey.

Forfar study suggested that the 2 hour post-glucose blood augar level is considerably more sensitive and specific than urine testing for sugar in the screening population. This has also been reported by Osserman and Starin (1961; U.S.Public Health Publication No.506 (1960); and Keen (1964). Keen reported from the Bedford study that urine testing was insensitive as preliminary screening procedure in identifying the undiagnosed diabetic, due to the fact that sensitivity greatly improved by testing the urine after a standard 50 gm glucose load, but this has in turn the disadvantage of yielding many false positive results, most of them being among young people, particularly men. This reflects the fact that renal threshold for glucose is lower in men than in women, and that it rises with age. In Forfar study, Stewart and Robertson, found that both the 2-hour blood sugar criteria (140 mgm per 100 ml and 130 mgm per 100 ml) detected nearly all of the diabetics who were recognised by the classical tolerance test. The $2\frac{1}{2}$ hour criterion was less satisfactory. The fasting blood sugar level missed many known diabetics and therefore could not be advocated. The use of a single blood sugar determination is subject to criticism, and the laboratory errors contribute directly to the diagnostic errors. Forfar study pointed out that a simple positive test will not allow permanent diagnosis of diabetes, and the authors suggested that the person should always be referred to have standard glucose tolerance test after positive 2-hour test.

The benefit of using a single test in a population survey is that "one determination" criter/ia has the advantage of simplicity in the clinic and economy in biochemistry time, and the fact that this procedure will be more acceptable to the patients, particularly in a mass survey.

The sensitivity and specificity findings in Forfar study resembles, in their general pattern, those described by Remein and Wilkerson (1961), who indicated that blood sugar tests were most efficient at 1 and 2 hour after eating; urine tests were most efficient at 2 hours after eating. At 97 per cent specificity for both Somogyi-Nelson blood sugar method and Benedict urine sugar test method, the blood sugar method screened out more than one and a half times as many cases of diabetes as the urine sugar method of equal specificity.

The specificity ratings of blood sugar tests by the Somogyi-Nelson and Wilkerson-Heftmann methods were satisfactory, being 98.0 and 96.8 per cent respectively (Kurlander, Iskraut & Kent, 1954), which means that all the non-diabetics would be classified by a screening test using these methods. However, the sensitivity rating for the same methods were low - 65.2 and 56.5 per cent respectively, which would indicate that a relatively low percentage of diabetics were detected by the screening test, using these methods at the level of 130 mgm per 100 ml blood glucose. In other words, 34.8 and 43.5 per cent respectively of those diagnosed as having diabetes had screening levels below 130 mgm per 100 ml, and theoretically would have been missed if that level had been arbitrarily set as the detection level.

Urine tests, using glucose-oxidase methods (tes-tape and clinistix) were more sensitive for equal specificity than was

Table 5 : Estimated percentage of popn. with glycosuria or abnormal glucose tolerance in the various categories using different methods of discovery

Method of Discovery	"Florid" diabetes	G.T.T. Diabetes	Non-diabetic glycosuria
Already known	0.64(16)	-	-
Glycosuria on enzyme test 1-2 hours after main meal excluding those already known	0.30(8)	0.39(10)	1.82(45)
Glycosuria on enzyme test 1-2 hours after 50 gm glucose excluding those already known and those with glycosuria after meal	(1)*	2.31(58)	10.99(275)
Discovered after routine G.T.T. on patients aglycosuric after 50 gm glucose	0	2.38(60)	-
Total	0.94(24)	5.08(128)	12.81(320)

Figure in parentheses are estimated numbers in a practice of 2,500 patients

* No rate can be calculated, as only one case was discovered.

Source : Coll.Gen.Pract. Working Party (1963), B.M.J., 2, 658

Benedict's urine sugar test (Remein & Wilkerson, 1961).

This means that there is no choice but to use a highly specific test with the glucose-oxidase method of testing the urine in a screening test.

The Birmingham Study (1963) again demonstrated the good sensitivity, and the poor specificity of the urine enzyme test. (Table 5).

Table 5 shows the estimated percentage of the general population who would be found to have abnormal glucose tolerance or glycosuria, using various testing techniques. The results are based on the findings from the survey and control groups, and have been corrected for age and sex to provide an estimate as to how many diabetics an average National Health Service practitioner (with 2500 patients on his list), might expect to find. Using enzyme testing (clinistix) after the main meal of the day, it is possible to uncover all the unknown "florid" diabetics, with symptoms, and 55 additional patients who will need watching. While enzyme testing 1-2 hour after 50 gm of oral glucose following 12 hours fasting will probably uncover no further florid diabetes, but it will add another 333 patients to the group who will need watching, making a total of 388. A routine glucose tolerance test adds 60 more cases with "glucose tolerance" diabetes, but no glycosuria, and without uncovering further florid cases. If "clinitest" rather than the enzyme test were used, the number of positive results could be reduced by about half (Redhead, 1960), but would include nearly all the florid cases.

The suggestion from the Birmingham study is that the testing of fasting specimens by clinitest would, for practical purposes, reveal only florid diabetes, but more than half of these cases awaiting diagnosis will not be found by this method. If he tests the urine of everyone on his list, using enzyme testing, the practitioner with 2500 patients would expect to discover 8 definite cases of diabetes, and about the same number showing symptomless abnormality of the glucose tolerance.

The sensitivity and specificity for each of five screening tests (fasting, post-prandial and post-glucose urine tests, and fasting and post-prandial blood glucose) were investigated in ten different countries. West and Kalbfleisch (1971), reported that each test varied widely among populations. The sensitivity of the 2 hour urine glucose ranged from 17 per cent in Nicaragua to 100 per cent in East Pakistan. It was therefore not possible to predict prevalence rates reliably by extrapolating from the results of screening tests. Specificity and sensitivity of such tests are influenced by many factors, including both the circumstances under which the tests are performed and the characteristics of the population tested. Those investigators have concluded that the rate of diabetes will be markedly influenced by the modest changes in diagnostic criteria. With few exceptions, tests which are more sensitive are comparably less specific and the reverse is also true.

Table 6 : Estimated percentage prevalence of normal and abnormal glucose tolerance in the general population

Category	Aged under 50	Aged over 50	Total
Known diabetics	0.21	1.57	0.64
"Diabetic" abnormality			
Florid	0.06	1.40	0.49
G.T.T.	1.32	13.09	5.08
Lag storage	5.18	17.94	9.26
Renal glycosuria	0.36	(1.25)	0.65
Miscellaneous Abnormality			
A (high fasting)	2.22	5.29	3.20
B (hump curves)	1.66	4.19	2.46
C (high 2-hours)	11.13	10.55	10.94
Unclassifiable	2.16	3.23	2.50
Normal	75.70	41.49	64.78
Total	100	100	100

Figure in parentheses is based on small numbers.

Working Party, Coll. Gen. Pract. (1963). B.M.J. 2, 657

Effect of age and sex

After the standard glucose tolerance test first established by Hamman and Hirschmann in 1917, many found that the glucose tolerance test results increased with age. Spence, in 1921, found the mean glucose tolerance curve for five men over sixty years of age to be considerably higher than that of six men, 25 to 39 years old. Porter and Langley in 1926, applying 50 gm glucose tolerance tests to over fifty men and women in the third and eighth decades of age, observed stepwise increases with age in mean blood sugar level obtained $\frac{1}{2}$, 1, $1\frac{1}{2}$, 2, and $2\frac{1}{2}$ hour after glucose administration. Hale-White and Payne in 1926, found that the peak of glucose tolerance curve rose with increasing age. Butterfield (1964), demonstrated that the level of blood sugar in the glucose tolerance curve rises with age.

The glucose tolerance of 281 normal women rose with the increase in age, and the peak glucose level shifted from 30 min. to 60 min. in the age group of over 70 years.

The effect of age on the glucose tolerance as criteria of diagnosis is obvious from Table 6.

This table shows the estimated percentage prevalence of normal and abnormal glucose tolerance in the general population, from the Birmingham study (1963). The estimated percentage is 6.21 per cent of abnormal glucose tolerance for all the population, while the abnormality percentage among those aged 50 and over is 16.06 per cent. The total normal percentage of those over 50 years of age is 41.49 per cent, compared with 64.78 per cent for all ages.

Moreover, the Birmingham study demonstrated that 11 out of the 12 persons who showed diabetic abnormality in a control group of 123 persons were above the age of 50 years. Of those over 50 years of age nearly half had some "abnormality" of the glucose tolerance curve.

Table 7. Mean capillary blood glucose (mgm/100 ml) for various age groups, fasting 1 hour and 2 hours after 50 gm of glucose.

Age Group	No. of Cases	Fasting B.S. Mean	Fasting B.S. S.D.	1 hour Mean	1 hour S.D.	2 hours Mean	2 hours S.D.
0 - 29	41	85.8	8.8	122.1	22.0	97.7	16.7
30 - 49	103	87.8	11.4	141.2	34.0	90.2	24.7
50 - 69	155	89.7	13.7	162.0	40.6	98.5	31.0
70+	46	99.1	16.3	186.0	43.3	118.8	44.4

Source: Birmingham Study. Coll.Gen.Pract., Working Party, B.M.J. (1963), 2, 658

Table 7 shows the mean capillary blood glucose with its standard deviation for various age groups, for fasting, 1 hour and 2 hour blood sugar. No diabetic abnormality was found under the age of 30 years, and only 2.9 per cent at the age group of 30.49. Starting from the age of 50 and over, however, about one in six of all men, and at 70 and over about one in four of all women, had a diabetic abnormality. The mean fasting blood sugar value was constant at 87 mgm per 100 ml, until the age of 70 years. At 70 years and over the increase, although significant, was comparatively slight (99.1 mgm). One hour after the glucose load, the mean blood-glucose values increased steadily with age, and showed a wide range of readings. At 2 hour the mean values still exceeds the fasting value and showed a greater range.

The decline with increasing age of the carbohydrate tolerance was also demonstrated by Gordon (1964) in a national health survey in the U.S.A., and his data shows that the distribution of mean blood glucose, 1 hour after 50 gm oral glucose, rose at a rate of 10 mgm per 100 ml for each decade of life (Table 8).

Table 8: Mean blood glucose levels 1 hour after 50 gm glucose by mouth, by age and sex

Age	Both Sexes	Men	Women
Total (18-79)	121.3	115.7	126.4
18 - 24	99.7	94.6	104.1
25 - 34	105.7	101.5	109.5
35 - 44	116.5	115.2	117.6
45 - 54	125.8	118.2	133.1
55 - 64	137.8	130.1	145.2
65 - 74	150.7	139.8	159.7
75 - 79	166.3	154.4	178.7

Source: U.S.Dept.of Health, Education and Welfare (1964
Glucose Tolerance of Adults:
National Centre for Health Statistics, Series 11, No.2.

The mean values for women were 10 mgm per 100 ml higher than those for men at all ages. Gordon, like Butterfield, suggested the unimodality of the glucose curve and explained this rise with age as being due to general changes, and not to the existence of a separate group of hyperglycaemia persons. One hour blood sugar values over 200 mgm per 100 ml occur in only 1 per cent of persons under the age of 35, but in about 12 per cent of those over 65 years (9.7 per cent of men, and 14 per cent of women). The percentage increase with age, mounts most rapidly after 55 years of age. Gordon also demonstrated the fact that the renal threshold for glucose is higher among women than among men, and in older persons rather than in the young.

The carbohydrate tolerance of adult people diminished progressively after the second decade of life (Hayner et al, 1965). Hayner et al, reported the result of their study in Tecumseh, Michigan, (1959-1960), and suggested that age and recent food intake, independently exerted striking effect on one hour level of glucose tolerance test. The study was done on 2,983 persons, 16 years of age and older. With increasing age through the seventh decade, the whole 1 hour glucosuria distribution shifted towards a higher level. The slope of its regression on age approximated 13 mgm per 100 ml per decade. This figure is comparable with that reported by Gordon (10 mgm per 100 ml). The Tecumseh study showed, with respect to 1 hour point of the glucose tolerance curve, that a majority of either sexes may be expected, as age progresses, to exceed the frequently accepted criterion of 160 mgm per 100 ml. In a similar manner, Butterfield (1969), explained that with the increasing proportion of older people, the 120 mgm per 100 ml after 2 hour criteria, will be exceeded. Jackson (1964) expressed the same opinion.

From this it appears that there is a great challenge for the diagnostic criteria which takes no account of age.

Hayner et al, suggested an age-adjusted criteria for the 1 hour level. They have constructed an age dependent criteria to try to find an answer to reclassifying the people who are designated as maturity-onset diabetes, who actually had diminished carbohydrate tolerance as a result of age progress, which is a characteristic of the entire population.

Hayner et al, postulated two modes to explain the change with age in carbohydrate tolerance of individuals: (a) Carbohydrate tolerance may decrease uniformly with age in most individuals. Rates of deterionation might be the same for all or might vary from person to person. (b) Individuals may sustain various degrees of abrupt injury to one or more components of the glucose haemostatic mechanism from time to time.

Prospective observation on sizable population segments might give a better idea as to which of these modes is more valid.

Undiagnosed and unknown diabetes

Because typically the onset of diabetes is gradual, and often without obvious symptoms, or because the symptoms are ignored or neglected, there are many persons with diabetes in whom the diagnosis has not as yet been made. The frequency of these cases is even more difficult to ascertain than that of known diabetes. Such information as is available is derived from various types of case detection activities. It has been learnt that the detection of those new diabetics always vary according to diagnostic standard adopted, nature and type of screening procedure, the type of populations screened, including the age-sex composition, and the extent of the response.

It is obvious that the data from the various studies discussed earlier can only give some idea of the dimensions of the problem of undiagnosed diabetes, but at the same time these studies are of little value in measuring the percentage of undiagnosed cases precisely.

The extent to which cases of diabetes mellitus remain undiagnosed has been investigated by Munro, Eaton and Glen from Glasgow (1949). They are of the opinion that those cases that are undiagnosed tend to be mild and without definite symptoms. They also showed that the lack of symptoms affected the two sexes to a different degree. For example, genital pruritus was the chief complaint in 26 per cent of the female cases, whereas it accounted for only 0.8 per cent among the male patients. They believe that a large number of their female patients would never have come for consultation were it not for the pruritus.

The extent to which diabetes remained undiagnosed was believed to vary at different ages in the Scottish population. The authors were able to make a direct approach to the problem of the true number of diabetics in the population by using data accumulated at the examination of army recruits. Among a group of 413,110 consecutive male and female Scottish recruits, between the ages of 17-45 years for males, and 17-35 years for females, they found an prevalence rate for diabetes mellitus of 1.74 per 1000 males and 0.37 per 1000 females. This indicates that the sex distribution of undiagnosed diabetes might not be the same as that for persons known to have the disease. Considering this statement, the authors suggested that it does not necessarily have to be true, for the number of females as army recruits is much less than the number of male recruits examined; and although numerically the young adult diabetics form an important group, incidence of the disease is more common in the older age group.

Estimation of the undiagnosed diabetics in the population which came from the U.S.A., have been published by the Diabetes and Arthritis Program of the Division of Chronic Diseases of the U.S.Public Health Service (Marks, Krall & White, 1971). These estimates were based upon a composite derived from the various detection studies and surveys. (Table 9).

Table 9: Comparison of estimated known and unknown case rates for diabetes mellitus: United States, July 1959 - June 1961

Age	Case Rate for 1000 Population			Ratio Unknown to Known	Per cent Unknown of Total
	Total	Known	Unknown		
All ages	17.9	9.8	8.1	0.83	45.25
Under 25	1.7	1.0	0.7	0.70	41.18
25 - 44	10.2	5.0	5.2	1.04	50.98
45 - 54	33.1	15.2	17.9	1.18	54.08
55 - 64	55.6	31.4	24.2	0.77	43.53
65 - 74	68.6	42.4	26.2	0.62	38.19
75+	62.0	37.5	24.5	0.65	39.52

Source: Joslin's Diabetes Mellitus (1971), Eleventh Edition, p.17. Lea and Febiger, Philadelphia

Table 9 gives the age specific rates for the undiagnosed cases, together with certain comparisons with estimated rates for undiagnosed cases from the U.S.National Health Survey for the period 1959-1961. The estimated rates for previously undiagnosed cases show a rapid rise up to the age of 45-54 years, but are relatively constant for ages 55 and over. The rate for known cases exceeds that for the unknown, due to the higher rate for known cases in the older age groups.

These figures are open to criticism, and the authors suggested that they should be considered at best only as rough approximations, since the underlying basis of the material is subject to many limitations, especially that of inadequate data at the younger ages in which diabetes is less prevalent. It is questionable, for example, that the rate and resulting estimate of over 60,000 undiagnosed cases in persons under the age of 25, as of mid-1965 (Table 10) are really reliable, in view of the frequently acute onset of the disease in that age group.

Table 10: Estimated prevalence of existing cases of diabetes mellitus by age: United States, July 1, 1965

Age	Number 000's			Ratio Unknown to Known	Per cent Unknown of Total
	Total	Known	Unknown		
All ages	4034	2458	1576	0.64	39.1
Under 25	181	118	63	0.53	34.8
25 - 44	547	304	243	0.80	44.4
45 - 64	1859	1053	806	0.77	43.4
65 - 74	741	640	301	0.47	32.0
75+	506	343	163	0.48	32.2

Source: Joslin's Diabetes Mellitus (1971). Eleventh Edition, p.17 Lea and Febiger, Philadelphia.

Table 10 shows figures which have been computed to show the estimated totals, by age, as of July 1, 1965, in which the rates from the U.S.National Health Survey for known cases in 1964-1965 and the rates shown in Table 9 for undiagnosed cases have been used. The validity of such composition is not quite known. The larger scale diabetes detection activities in recent years may have reduced the proportion of undiagnosed cases. However, there is not sufficient information on the matter from statistical data, nor is there any on the changing frequency of newly developed cases. The results of the computations showed an estimated total of slightly more than 4,000,000 cases, of which approximately 60 per cent are known cases and 40 per cent are undiagnosed cases. Approximately 80 per cent of the total number of patients are 45 years of age or older. In view of the rise in reported case rates for diagnosed diabetes since 1959-1961, the assumption of static rates for the undiagnosed, reduced the ratio of the latter to the diagnosed and to the total. At all ages combined, the ratio of patients with undiagnosed cases comprised 39 per cent of the total. Moreover, Marks, et al, estimated that the total prevalence, known and unknown, increased to 4,359,000 in 1965-1966, due to the rise in known cases, based upon the survey in that year (McDonald, 1968). Accordingly, the ratio of estimated unknown cases to the total has decreased only slightly.

Another point regarding the validity of the estimated total prevalence is that when these estimates are compared with the mortality figures they might be slightly unrealistic, or they might be explained on other bases with the consequence of blaming the mortality figures (Marks, Krall & White, 1971). To see the effect of the estimated prevalence on the mortality figures, the estimated prevalence in the United States in the year 1965, would appear to be generous when compared with the recorded mortality from diabetes in the same year. Estimated deaths ascribed to diabetes were about 33,000, and the total number of deaths with diabetes mentioned in the death certificate may be as high as 80,000. This is equivalent to a rate of 20 per 1000, based on the estimated total, including the undiagnosed, and 33 per 1000 based upon the diagnosed cases only. The authors suggested that the latter figure is reasonable in relation to available information on the mortality of diabetes and in relation to the age distribution of the disease, but the former is unrealistic unless a large proportion of diabetics are undiagnosed at time of death; or the diabetes is not mentioned on the death certificate. This has several components: A doctor, who was new to the deceased, may sign a certificate without a knowledge of the existence of diabetes; the actual cause of death may seemingly, and in fact, bear little relation to diabetes, and so the word "Diabetes" is deliberately omitted; the diabetes may have so burned out in the old man or old woman, that it is not recognised at the time of death, or because of its mildness may never have been diagnosed.

These factors in turn explain the effect of the mortality on the known prevalence of diabetes, if such prevalence would be estimated from mortality figures. Moreover, in recent years, the pattern of recording on the death certificate has been altered to conform with that suggested by the International Classification of Diseases.

Many workers reported that the result of the change to the international form was that diabetes is not mentioned in the death certificate of a higher proportion of patients dying with diabetes (Joslin, & Krall, 1959; Cameron, 1966). This suggests that estimating the prevalence of diabetes from mortality statistics is not a reliable method.

Borderline diabetes

The major benefit of a detection survey is that it will reveal a certain number of florid cases of diabetes, mostly with diabetic symptoms, who can be relieved of those symptoms, and also of the risk of infection. These surveys would also discover cases, usually called "borderline" cases or "blood-sugar suspect" group. This group consists of persons lying in the middle of the spectrum, between the normal and the florid diabetes.

The course of events in those with borderline diabetes was observed in the follow-up studies. One such follow-up is that which was done to persons from the Oxford original survey (1946-47). Wilkerson and Krall (1953), reported a four-year follow-up of 118 persons who were labelled as "blood-sugar suspect" group in the original survey. Among these 118 persons from the original survey, 17 diabetics were discovered during the interim period of 4 years, which is equal to 14.4 per cent of the whole group. A control group with normal blood sugar, of 225 persons, was also followed up and 4 of them developed diabetes at the end of 4 years. This equals 1.8 per cent of the 225 persons.

Among a group of 17 persons with unclassified glycosuria in the original survey, 4 have become diabetics in the 4-year interval, 3 of them being included also in the blood-sugar suspect group. The authors suggest that it is more likely that diabetes develops in such persons with borderline blood sugar, more than in persons with average or normal blood sugar. Moreover, they suggested that persons with relatively high but not diagnostic blood sugar levels should be periodically followed up. They also suggested that the incidence in the glycosuria group suggests that the allegedly harmless glycosuria may often hide incipient diabetes.

Another follow-up in 1953, reported by Wilkerson, Krall and Butler (1959), showed that persons classified as suspect group, were 8 times as likely as the normals to appear later in the diabetic group.

In the Birmingham survey 465 glucose tolerance tests were done, and 5 years later they were repeated (Fitzgerald, 1966). Those with borderline abnormality on the first occasion tended to show deterioration at the second (8 out of 39). The higher the values at the first test the greater the chance of florid diabetic abnormality being seen at the second. Seven of the 19 with 2 hour blood sugar over 150 mgm per 100 ml at the first examination, showed florid diabetes at the second, whereas only 1 out of 20

* After four years of follow-up Keen reported the following blood sugar results for the borderline cases in whom the blood sugar in the original study in 1962 ranged between 120 - 200 mgm. per 100 ml. 2 hours after 50 gm. of oral glucose.

Treatment Group		Mean B.S. mgm/100 ml.	Per cent <120 mgm. per 100 ml.	Per cent unchanged	Per cent 200 + per 100 ml.
Tolbutamide (mgm/day)	Carbohydrate restriction				
6	0	147.1	35.3	57.7	7.0
1000	0	148.6	21.7	64.3	14.0
6	+	155.7	26.7	63.7	9.6
1000	+	151.3	30.7	58.4	10.9

with 2 hour values of 120-150 mgm per 100 ml did so. Those with lag storage curves were improved or unchanged; only 14 per cent showed borderline or definitely diabetic curves 5 years later. In this survey no person with renal glycosuria did develop diabetes after 5 years.

Keen (1966), in an attempt to show the influence of diet or tolbutamide in the 200 persons who had been classified as borderline cases in the original Bedford survey, divided them into 4 quarters. A quarter have been treated by carbohydrate restricted diet, a quarter by tolbutamide, a quarter by both, and a quarter by neither. He tried to examine the effect of diet or tolbutamide on the course of events, in respect of the progression of these borderline cases to frank diabetes, or the appearance of diabetic complications. The results were such that there is very little evidence on which to decide whether to treat these people or to withhold treatment.*

Such questions as to whether it would be right to withhold treatment from people with borderline diabetes, or would it be wasteful to treat those persons with normal blood sugar levels but with glycosuria, are difficult to answer; simply because the definition of diabetic abnormality is arbitrary. It is difficult to decide whether the borderline group should be regarded as diabetics or normal. Unless and until there is some way of identifying diabetes independently of blood-glucose measurement, and until the follow-up reports of the borderline cases by organised trials is well documented, the answer to the problem of borderline diabetes will remain incomplete. With our present knowledge the diagnostic definition depends on the glucose tolerance test, and the factors affecting it must be kept in mind when interpreting the findings of such a test. The decision in any particular borderline case, whether to treat, watch or ignore, will depend upon the personal judgment of the physician interpreting the glucose tolerance test, and studying the patient's past, family, and when applicable, the obstetric history.

The advantages of medical care to those with borderline blood sugar, who are overweight, is obvious, for example, to advise weight reduction and to keep them under close watch during infection, pregnancy, or other illness. Marble (1971a), supports the idea that early treatment improves the diabetic state, and may delay, if not prevent, complications. Although this point is still arguable, the practice of most specialists is to follow up the borderline cases to start the treatment when the change from abnormal tolerance to a true diabetic one occurs.

If the object of a survey is to detect cases of significant diabetes, the field can be greatly and profitably narrowed. The discovery of a family history of the disease, or history of obesity, the recollection of women of a child weighing more than 10 lbs. at birth, or the bearing of more than six children, yields groups which are known to be unduly susceptible to diabetes. If, in addition, the search is restricted to those who are more than 50 years of age, the proportion of florid diabetes will surely justify such an effort and justify its repetition at regular intervals. The prevalence of known diabetics attending hospitals or clinics gives a more realistic picture of the immediate problem. The evaluation of the medical care and suggestions regarding organisation of the health services would be more practical if directed towards the "real" frequency of known diabetes among the population.

Requirements and aims of studying diabetes prevalence

The requirements or the criteria for an epidemiological study seeking to determine diabetes prevalence, could be summarised under two headings: (a) population definitions, and (b) disease definition.

The prevalence of diabetes based on patients' hospital or clinical records, would be affected mainly by the population definition, but hardly affected by the second factor, which is the disease definition. The diagnosis of diabetes among the hospital or clinic diabetic population would be established on clinical examination and history taking, in addition to laboratory investigation. The prevalence reported from studying diabetics as they present themselves to the hospital services, gives the real magnitude of the problem in practical terms.

Munro, Eaton and Glen (1949), have demonstrated that the diabetic clinic population is a representative of the diabetic population in general. They have studied a group of 1309 diabetics attending the diabetic clinic at the Victoria Royal Infirmary, Glasgow, and calculated that these diabetics are representative of Scottish diabetics,since the sex distribution among them corresponded to the sex distribution of deaths from diabetes recorded in the official mortality statistics for Scotland.

To record the prevalence accurately enough in studies based on examining the patients' records in hospital clinics, all the general practitioners, medical and para-medical institutions in the area of study, should be contacted to obtain information about the diabetics. Falconer, Duncan and Smith (1971), adopting this method, reported a reliable estimate of the prevalence of diabetes in Edinburgh (0.63 per cent). This figure is almost the same as that recorded by the Birmingham study (0.64 per cent), for known diabetics.

The Birmingham study, like most of whole population studies, depended on testing the population for the presence of diabetes. In this kind of survey the value of the population definition is clear, but what is not known is the degree of definition needed. A marked enumeration error would be required to have significant effect on the prevalence of low frequency diseases like diabetes. O'Sullivan, Wilkerson and Krall (1966), re-analysed the findings of the pioneer study of diabetes in the town of Oxford, Massachusetts (1946). The use of a census obtained in the year 1964 would affect certain age groups, which, in an instant, resulted in a 2 per cent over-statement of the prevalence of diabetes, from 9.7 per cent to 11.6 per cent, in the age group 75 and over. By contrast, the total population prevalence figure was accurate to one decimal place of that published originally (1.6 per cent as compared to 1.7 per cent). This confirms that in a disease with low frequency, the final percentage is relatively insensitive to minor degrees of variation in population definition. On the other hand, age specific numbers are more vulnerable to such error, because small numbers are involved and are therefore of greater importance in such diseases like diabetes, whose incidence varies with age.

The information from current and accurate census of the population under study, distinguishes a true epidemiological study from a case-finding survey. In surveys done to discover undiagnosed diabetics the aim will be to attract high susceptible groups of the population. Hence the respondent rate is an important factor affected by the tendency for the older persons to be less co-operative, and known diabetics to participate more readily than the population as a whole

Disease definition: Under this heading comes the following factors: acceptance of known diabetics; variety of diagnostic end point; method of discovery and selective application of the test; and quality and variety of laboratory measurements.

Diabetes prevalence contributed by the known diabetics is dependent on local diagnostic habits; consequently if the diagnostic standards are not uniform, or they are different from the standard used in the study, the effect on this group will be considerable on the final prevalence results. To ensure good prevalence data, it is essential to obtain and report adequate confirmatory tests on all such stated "diabetics".

A random population sample of the town of Sudbury (O'Sullivan and Williams, 1966; O'Sullivan, Williams and McDonald, 1967), have been subjected to oral glucose tolerance test, and the results of fasting, blood-sugar, and that at 1, 2 and 3 hour after glucose feeding was recorded. Depending on whether one, two or three elevated values were used as the critical diagnostic criterion, the results in prevalence rate of abnormality varied. It varied from 1.2 per cent when three values were chosen, to 13.8 per cent when only one elevated value was thought to be enough to diagnose the abnormality (O'Sullivan, 1969).

The result of the glucose tolerance test performed on persons without glycosuria (control group of 345) in the Birmingham study (Table 2), showed abnormality in 7.8 per cent, or 11 times the number of glucose tolerance abnormalities found when those with glycosuria were tested and accepted as representing the population. Selective application of diagnostic test, although good practice in clinical sense, is unsatisfactory in epidemiological work. The diagnostic criteria should not be performed on persons in a "high risk group" only, as, by restricting the application to the "high risk group" the result will fail to recognise the large fluctuations in blood sugar values seen within the individual. And if applied to population studies, it will grossly bias the primary value of representative data. O'Sullivan (1969), indicated that the glucose tolerance test prevalence is 0.8 per cent when only persons who have a suspicious blood sugar "post-prandial" are given the test, but the prevalence shoots up to

1.2 per cent when there is no pre-screening requirements.

Marked quantitative differences will result if one hour post-glucose blood sugar capillary value (30 mgm per 100 ml higher) is used instead of the corresponding figure of venous blood sugar. Similarly, plasma, or serum value is 14 per centhigher than conincidentally obtained whole blood values.

Technical problems are important, such as preservation of the specimen before the assay, differences in different chemical methods (e.g. Folin-Wu versus Somogyi-Nelson). The autoanalyser (Hoffman) method gives values that are on average 8 mgm higher when blood specimens are run following haemolysis, than those obtained on fresh whole blood (Table 11).

Table 11: Serum glucose aliquots in three epidemiological studies

Study	AutoAnalyser glucose values		
	No.	Means (mg per 100 ml)	Standard deviation
A	38	103.6	3.7
B	36	100.9	9.8
C	35	106.2	2.7

Source: Proceedings of the 6th International Diabetes Federation (1969): pp.699, Excerpta Medica, Amsterdam.

Table 11 gives the blood sugar results for prepared serum glucose pool, performed as part of a program to determine the feasibility of achieving direct inter-study compatibility. The specimens were all from the same serum pool and introduced as (blind) quality control in three epidemiological studies. The difference in mean blood sugar level obtained, as well as the differences in the variability of the results, are seen by the standard deviation, which will invalidate many of the later comparisons attempted from the completed studies.

Aims of estimating diabetes prevalence

One aim of estimating the frequency of diabetes among the population is to study its aetiology and to construct a picture of the disease sufficiently complete to show the effect of inheritance and environment. Another aim is that it should be helpful in planning the organisation of medical care, hospital accommodation, and the allocation of research funds. Most of the surveys were based on whole population study. These surveys gave the estimated frequency of the already known diabetics and the previously unknown diabetics who have been discovered by the survey. The advantage of population surveys is to give the overall picture of the disease prevalence, and provide information about its nature and mode of occurrence among the population.

The estimated prevalence from hospital or clinic records on the other hand, will not uncover the undiagnosed diabetics, but it has the advantage of providing information regarding the examination of the health services as it is provided for, and utilised by, the diabetics. Practical evaluation of the health services may thus be discussed and described on the basis of the existing magnitude of the problem.

The whole population study will indicate a problem which is not presenting itself to the hospital and clinic services, except during the period of a survey. These circumstances will no longer arise when the survey is over unless a profound change takes place in the general practice to try to adopt the method of discovery on a permanent basis.

Types of Diabetes Mellitus

The recommendation put forward by the medical and scientific section of the British Diabetic Association (Fitzgerald & Keen, 1964), did much to clarify the existing confusion in the terminology used to define early stages of diabetes, and are now generally accepted in the United Kingdom and Europe (Table 12).

Table 12: The diagnostic classification of diabetes

1. Potential:

People with a normal glucose tolerance test* but with an increased potential risk of developing diabetes:

a. An identical twin, the other twin being diabetic.
b. A person with both parents diabetic.
c. A person with one diabetic parent whose other (non-diabetic) parent has, or had, either a diabetic parent, sibling, or offspring or a sibling having a diabetic child.
d. A woman who has given birth to a live or stillborn child weighing 10 lb (4.5 kg) or more at birth, or a stillborn child showing hyperplasia of the pancreatic islets not due to rhesus incompatibility.

2. Latent:

a. A person with normal glucose tolerance test* who is known to have had a diabetic glucose tolerance test* at some time during pregnancy, infection, or other stress or when obese.
b. A person who has abnormal blood glucose responses (similar to those found in diabetes mellitus) to provocative tests such as the cortisone augmented GTT or the intravenous sodium tolbutamide test.

3. Asymptomatic (sometimes referred to as subclinical or chemical):

a. A person with a diabetic response to the GTT* whose fasting blood sugar is below 130 mg per 100 ml (capillary) or 125 mg per 100 ml (venous).
b. As above, but with fasting blood sugars above the stated values.

(Table 12 contd.)

4. Clinical:

A person with an abnormal glucose tolerance test* with the symptoms or complications of diabetes.

The term "prediabetic" is reserved for the period in the life of a diabetic before the diagnosis is made.

Oral glucose tolerance test

Conditions:

Unrestricted diet and physical activity for at least 3 days, 12 hours of fasting, and 30 minutes' sitting quietly before the test. Subject to remain seated and non-smoking during the test.

Method:

After withdrawing the fasting blood sample, 50 g glucose in 200-500 ml of flavoured water to be drunk in 5 minutes. Zero time to be taken as the beginning of the drink and samples to be withdrawn at 30-minute intervals for 2 hours.

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*Standard of abnormality:

Capillary blood glucose level of 120 mg per 100 ml or more at 2 hours and of 180mg per 100 ml or over at some other time point in the test. (Corresponding venous blood glucose values 110 mg and 160 mg per 100 ml respectively.) The blood glucose values above refer to measurements by either the glucose oxidase method or ferricyanide method after dialysis using the Autoanalyser.

Source: Fitzgerald, M.G. & Keen, H. (1964). Lancet, I, 1325

Potential diabetics exhibit glucose tolerance levels within normal limits but are considered at significantly greater risk of developing diabetes than the general population. Among potential diabetics are the identical twin of a diabetic, the offspring of two diabetic parents, other persons with diabetes in several close relatives, and women with a suggestive obstetric history.

Latent diabetics have normal glucose tolerance but are known to have had a diabetic glucose tolerance in the past, usually during a pregnancy, an infection, or some other type of stress like obesity. Persons with an otherwise normal glucose tolerance which becomes abnormal during tests combining glucose with other provocative measures, e.g. the cortisone-augmented glucose tolerance test - are similarly considered to have latent diabetes.

Asymptomatic (or subclinical, or chemical) diabetics are persons with inappropriate hyperglycaemia but without significant glycosuria, and without any other symptom, sign, or complication of the disease. In the presence of any of the latter, diabetes becomes clinical or overt.

The only remaining confusion is in the use of the term, prediabetes. In North America this word is used in the sense that potential diabetes is used in the United Kingdom. In France prediabetes is used to denote subclinical or latent diabetes.

It has been shown clearly that not all potential diabetics eventually develop clinical or even chemical diabetes (Cook, et al, 1966; Khan, et al, 1969; Pyke, 1970). Thus the word prediabetes should be confined to the period in life of the diabetic before the diagnosis was made. It therefore should be used as a retrospective diagnosis defining the presymptomatic period in the life of a diabetic.

World Health Organisation Expert Committee (1966) used a similar nomenclature to that proposed by Fitzgerald and Keen.

Since carbohydrate and lipids are the major energy substrate in man, it is only to be expected that as biochemical testing becomes more sophisticated, derangements of glucose and lipids metabolism will be found in many diseases. An editorial in the Lancet (1971a) suggested that because more and more diseases are now found to be associated with abnormalities of carbohydrate and lipids metabolism, it is more appropriate to consider diabetes mellitus as a syndrome rather than a specific disease.

The clinical syndrome of diabetes mellitus was usefully subdivided into acute and chronic varieties by Renold, et al (1972). The acute diabetic syndrome includes patients in whom the syndrome presents suddenly with rapidly progressive symptoms. The symptoms are readily explained as they are a manifestation derived from the cardinal manifestation - hyperglycaemia. With increasing hyperglycaemia the renal threshold for glucose will be exceeded, and glycosuria polyuria results. Loss of water and glucose leads to thirst and hunger. Glucose loss, by draining the carbohydrate supplies, results in increased need for mobilisation and catabolism of proteins and fat. This will result in weight loss, and when mobilisation of fat becomes excessive, a state of increased ketone bodies in the blood and urine will result (ketonuria and ketonaemia). Insulin therapy is life-saving in patients with the acute syndrome.

Although this is often considered to be the classical form of the disease, it probably accounts for only 5-10 per cent of the new patients seen in clinical practice. Most commonly, the acute syndrome develops in those under 30 years of age, but no age group is exempt; and it is wrong to assume that just because diabetes declares itself during the age of maturity, it is automatically the non-ketotic type. Equally, it is now realised that maturity-type diabetes is beginning to appear among teenagers (Duncan, 1973).

The more common chronic diabetic syndrome (often referred to as the maturity-onset variety) with age of onset of over 40 years, accounts for the majority of diabetics in the world. Patients of this variety seldom need insulin to control their symptoms, and are less prone to ketoacidosis. In addition to some or all of the manifestations of the acute diabetic syndrome, patients of the chronic variety show symptoms associated with the presence of diabetes with long duration. A large part of these manifestations appear to have a vascular basis, sometimes interpreted as accelerated vascular ageing, although more specific alterations of capillaries, arterioles and venules are frequently present, particularly in the eyes and kidneys. The presence of abnormal deposits of glycogen, mucopolysaccharides and glycoproteins in diabetic cells in general, and in the basement membrane of capillaries in particular, has led to the suggestion that a metabolic aberration of small-vessel walls might be at the origin of many pathological and clinical manifestations of the chronic diabetic syndrome (Friedenwald, 1950; Le Compte, 1955; Bloodworth, 1963; Rees, et al, 1964; Beavan, 1965; Marble, 1967).

Whether the acute and chronic diabetic syndromes are directly related causally is as yet uncertain. It is probably true and there is evidence that different aetiological factors may be operating in the two groups. For example, it has been shown by Irvine, et al (1970), that there is a high incidence of organ-specific autoimmune disease in those with the acute syndrome, but not in those of the chronic variety. Moreover, it is now recognised that diabetes as defined by hyperglycaemia will include many diseases which affect the carbohydrate metabolism.

A number of conditions are thus being anticipated as aetiological factors, among which the final pathophysiological lesion, namely, ineffective or deficient insulin is the only common factor. For this reason the blood glucose estimation, although providing the usually accepted criteria for diagnosis, may not eventually prove to be the most sensitive index of the underlying disease. Keen (1968), reviewed the diagnostic definition of diabetes and pointed out that there is a need for a blood sugar-independent indicator of diabetes. However, and despite this word of caution, in 1974 blood glucose estimation remains the mainstay of the definition of the syndrome.

Epidemiological studies have demonstrated that there are ethnic variations in the clinical types of diabetes, and that the two syndromes are not equally represented in different ethnic groups. The Pima Indians, among whom the prevalence of diabetes exceeds 20 per cent, ketosis is uncommon (Miller, et al, 1965). Ketosis is also uncommon among Japanese (Rudnick & Anderson, 1962), Sinhalese (Dezoysa, 1951), and South African Indians (Walker, et al, 1964). Among the Navajo Indians in the United States, diabetes mellitus is not uncommon, but ketoacidosis is rarely seen, and the maturity onset variety being the predominating type (Saiki & Rimoin, 1968).

The prevalence of vascular complication of diabetes also shows ethnic variation. Miller, et al, (1968), showed that vascular complications are common among Pima Indians. These complications were also common among South African Indians, but rare among Japanese and Sinhalese. Among South African Negroes diabetic retinopathy is common, but myocardial ischaemia is rare (Seftel & Walker, 1966).

The division of cases into acute (Juvenile) and chronic (Maturity) onset diabetes does not quite fit the pattern of diabetes as seen in tropical countries. Classical cases of both categories occur, but in addition there are other patients who cannot be fitted into these sub-divisions. In addition to the two main groups, three sub-groups of diabetes have been described from Natal, Uganda and Jamaica. Campbell, who divides his older patients into: (1) senile (over 60 years at onset), and (2) maturity onset (onset age 40 to 60 years) (Campbell & McNeill, 1959), has described the "Insulin-independent young diabetic" (1960).

From Uganda, Shaper reported 'Variant K' (1958), while Hugh-Jones in Jamaica described the 'J' type (1955).

The "Insulin-independent young diabetic" presented with classical symptoms and signs of acute diabetes. Seventy-five per cent were female. All were satisfactorily controlled on the sulphonylurea drugs. There seems to be nothing to distinguish these cases from the obese maturity onset type, either in clinical behaviour or response to therapy, apart from their age of onset.

The "J" type was first reported by Hugh-Jones (1955) from Jamaica, and since then similar cases have been seen in Malaya, Indonesia, Ghana, Natal, the Congo, Kenya, Tanganika, Uganda, Nyasaland, Fiji, Nauru, Brunei and New Guinea. The essential clinical features are that the patients are young, underweight, require a large dose of insulin per day to control their glycosuria, and do not become ketotic if insulin is stopped (Tulloch, 1962).

Campbell (1960), who summarised the main clinical features of the three subgroups had concluded that there is no significant clinical difference between the "J" type and the "K" variant, except for the insulin requirement. The "K" type patients need about 70 units of insulin daily, while those of the "J" type need more than 100 units daily to keep in good health.

Aetiologies

The tendency for diabetes to run in families is an old and undisputed fact. Gottlieb and Root (1968), reported that there is a high concordance rate for diabetes in monozygotic twins. The incidence of diabetes in dizygotic twins is much lower than in monozygotic and roughly similar to that foubd in the first degree relatives of patients with diabetes.

These findings provide the best evidence for the hereditary nature of the syndrome. However, the mode of inheritance remains in dispute. Pincus and White (1933), proposed that the familial incidence was best explained by assuming that diabetes was inherited as a single recessive gene. This mode of inheritance would predict that the incidence of diabetes in the offspring of conjugal diabetic patients would be equal to the concordance rate for diabetes in monozygotic twins. However, Cook, et al, (1966); Khan, et al (1969), and Pyke (1970), have reported that the incidence of the disease in children of diabetic parents is only about 6 per cent.

Detailed biochemical studies on potential diabetics have shown an abnormally low insulin response to hyperglycaemia (Soeldner, et al, 1968; Cerasi and Luft, 1967; Serrano-Rios, et al, 1970). In these instances it appears to be the early phase of insulin secretion that is reduced in the potential diabetics. Cerasi and Luft also found this type of abnormality in 15-20 per cent of unselected healthy adults. Abnormal growth hormone secretion has been reported in half of the male offspring of conjugal diabetics (Soeldner, et al, 1971).

Siperstein (1970), reported a high incidence of basement membrane thickening in the capillaries of diabetics (99 per cent). Similar changes were present in 53 per cent of potential diabetics (offspring of conjugal diabetic parents) and 8 per cent of normal subjects with no family history of diabetes. He argues that, by affecting the blood supply to the islet, the micro-angiopathy may be the cause and not the effect of the syndrome. However, his findings have been challenged on several occasions and Williamson (1971), using a similar technique, was unable to confirm them.

Another controversy is involved in determining the significance of Vallance-Owen's observations on the "synalbumin" antagonist. According to his hypothesis, diabetes is due to the presence of an excess of a circulating antagonist to the peripheral action of insulin. This antagonist is associated with plasma albumin (hence "synalbumin"), and its presence is proposed to lead to a state of relative insulin resistance which eventually, by exhausting the B-cells, results in islet cell failure. The synalbumin antagonist is inherited as a Mendelian dominant character and has been claimed to be a genetic marker for the disease (Vallance-Owen, 1966). This hypothesis has caused a great deal of controversy. It does not appear, nowadays, to be compatible with the generally accepted observations that potential diabetics show lower levels of circulating insulin than age- and weight-matched normal subjects.

There is little or no controversy as to the importance of genetics in the diabetic syndromes that have been found in small rodents. The exact mode of inheritance has been worked out for the C57 Black Mouse (Hummel, et al, 1966). The diabetic syndrome in this species of mouse appears to be an expression of a single autosomal recessive gene (db), with complete penetrance in homozygous mice (db/db). Other diabetic syndromes are recognised in small animals.

Edwards (1970), suggested that there is no simple genetic explanation for the inheritance of the diabetic syndrome in man. It must then be concluded that environmental factors are probably as important as genetic ones in determining the development of the overt diabetic syndrome.

Butterfield (1971) said: ".... Just as there are many causes of heart failure, so there must be many causes of breakdown of the body's insulin glucose economy and the development of hyperglycaemia." He reviewed the various steps in the synthesis and action of insulin, and showed that many different factors may precipitate diabetes.

Inadequate supply of the amino acids needed for the synthesis of insulin or inadequate B-cell circulation, results in quantitative abnormality in insulin secretion.

The B-cell synthetic process may itself be defective. Butterfield suggested that one way to explain the increasing tendency to diabetes with increasing age is to accume that, like other cells, with increasing age, the increasing proportion of B-cells develop a shortage of chromosomes (so-called anenploidy), which may be important in the causation of diabetes.

Breakdown in the normal mechanism for the release of insulin may cause the diabetic defect. Insulin release is suppressed by adrenaline which is present in increased amounts in stress situations like pain, operations, burns, or acute coronary artery occlusion. Butterfield suggested that the exact relationship between diabetes and coronary artery disease is likely to be confused by studies which neglect this factor or overlook the influence of bed rest on the impairment of carbohydrate tolerance in such cases.

Insulin release on the other hand, may be stimulated by various gut hormones. Infusion of secretin raises the levels of circulating immunoreactive insulin, as can glucagon injections. Most recently, data on insulin and glucagon release, in response to a variety of stimuli in subjects with various degrees of glucose intolerance, have been studied by Vinik, et al (1974). They have shown that differential and selective functional impairment of both alpha and beta pancreatic cells is characteristic in that the glucoreceptor mechanism of islet cell is damaged early in both "genetic" and "acquired" model of diabetes. The response of both insulin and glucagon to hyperglycaemia is impaired, while the response to gut hormones (and hence to food) remains relatively intact. They put forward the following hypothesis: "The early lesion in these syndromes of diabetes may thus be an acquired or inherited selective blindness of alpha and beta cells to glucose."

More interest is now being directed towards the possibility that insulin is trapped in the general circulation by changes in the basement membrane, particularly the basement membrane in the muscle capillaries. Many studies have demonstrated that there is marked restriction of peripheral glucose uptake in obesity as well as in diabetes.

It is accepted now that at lease two factors are probably operating on the peripheral glucose uptake in obese subjects - some restriction of insulin filtration and a marked reduction of insulin sensitivity of the peripheral tissue. Impaired ability to dispose of glucose in the peripheral tissue in the obese will ensue if the B-cells cannot maintain adequate insulin supplies.

It is well known that there is a strong association between obesity and diabetes (Lancet, 1971b;Bloom, 1971). In man obesity is common in the adult diabetic, but less common in the younger patients. Pyke and Please (1957), found a similar prevalence of obesity (greater than 110 per cent mean normal weight) in diabetic and non-diabetic subjects under 30 year. Over the age of 30, obesity was twice as common in diabetics.

Plasma insulin levels are higher in obese than in non-obese subjects. Plasma insulin is lower in the obese diabetics than in the obese non-diabetic, provided that the groups are accurately matched for age and degree of obesity (Kipnis, 1968). Hyperinsulaemia, seen in obese subjects, is generally held to reflect adipose tissue insensitivity to the peripheral action of insulin (Lancet a,1970).

Obesity seems to be genetically linked in most of the experimental animal models so far reported. It is of interest that in contrast to the genetically obese diabetic rodents, hyperphagia induced by the administration of gold thioglucose or electrolytic lesions in the hypothalamus (Coleman & Hummel, 1970), produces obesity and hyperinsulinaemia before there is any marked tendency towards hyperglycaemia.

In man obesity and genetic predisposition to diabetes has been studied by Baird, et al (1967). In a study of the siblings of diabetic propositi and siblings of matched controls, it was found that, while diabetes was almost three times as common in the siblings of the diabetic proporiti, the rate was highest in the obese siblings of non-obese diabetics. Medley (1965), observed that the presence of a positive family history or a history of big babies was more important in determining abnormal (intravenous) glucose tolerance than either the degree or the duration of obesity.

Karam, et al (1963), showed that excessively obese people have high levels of circulating insulin, and Abrams, et al, (1969), demonstrated a connection between ponderol index and the insulin response to glucose across the normal range of adiposity. This suggests that the genetically predisposed, having to produce excessive quantities of insulin, eventually develop pancreatic exhaustion. This hypothesis is supported so far only by circumstantial evidence. However, studies done by West and Kalbfleisch (1966, 1970), produced evidence for the predominant effect of adiposity among the environmental factors which determine the prevalence of maturity-onset diabetes. Using standard methods, age-matched groups, and representative population samples, they determined the prevalence of diabetes among different ethnic groups in Asia, North, Central and South America. Although, as has been discussed earlier, they have noted large differences in overall prevalence, when races or populations were matched for adiposity, the differences were very small. They suggested that while there may be racial and genetic differences in susceptibility, environmental factors, particularly obesity, play by far the largest part in determining the overall prevalence of diabetes.

It seems, therefore, that the overall prevalence of maturity-onset diabetes in a community is largely determined by the prevalence of obesity, and that in communities where obesity is common, other environmental and genetic factors interact with obesity to determine both the occurrence and time of appearance of diabetes in the individual.

Secondary diabetes

Abnormalities in glucose metabolism occur in a number of other diseases which are termed as "secondary diabetes". These cases account for less than 5 per cent of all patients with diabetes Sönksen, 1972). Although these patients numerically represent only a small fraction of all diabetics, they are of considerable interest, since they provide information about possible aetiological factors that may be operating in the more common variety of the disease.

Sönksen grouped the possible causes of secondary diabetes under four headings: (a) causes in which the onset is preceded by hyperinsulinaemia, leading to eventual exhaustion of B-cells which include conditions like acromegaly, Cushing's syndrome, pregnancy, oral contraceptive therapy and obesity; (b) destruction of B-cells, e.g. pancreatectomy, carcinoma of pancreas, haemochromatosis; (c) inhibition of insulin secretion which, due to either excess of catecholamine activity, as in cases of thyrotoxicosis, pheochromocytoma, myocardial infarction, and burns, or due to potassium depletion which occurs in cases of aldosterone-producing tumours or following diuretic therapy; (d) causes linked with autoimmune disease which includes diabetes seen in cases with Myxoedema, Addison's disease, pernicious anaemia, and thyrotoxicosis.

Although it is said that secondary diabetes only develops in subjects who are genetically predisposed to diabetes, evidence of high incidence of diabetes in acromegaly (Sönksen, et al, 1967), and in Cushing's syndrome (Williams, 1968a) would make this unlikely.

Out of 16 patients with acromegaly studied by Sönksen, et al, 7 had impaired carbohydrate intolerance, including 2 with symptomatic diabetes.

Approximately 25 per cent of acromegalies studied by Williams have been found to have definite diabetes, and an additional 25 per cent have a decrease in glucose tolerance. Williams also reported that frank diabetes was found in 26 per cent, and an additional 55 per cent had impaired tolerance test out of a total of 174 cases of Cushing's syndrome.

High proportion of cases with acromegaly develop diabetes. The underlying abnormality is excessive production of growth hormone, which counteracts insulin (Young, 1963). Injections of growth hormone induce severe ketosis in insulin-treated juvenile diabetics. Growth hormone has an action like a fat-mobilizing substance, and it is possible that the fat released from the adipose tissue blocks muscle glucose uptake through the operation of the "glucose-fatty acid cycle", described by Randle, et al (1963). As it has been said earlier, glucose and fatty acids are the two major energy producing subtrates in man. There is normally a reciprocal relationship between the metabolism of these fuels: glucose providing the main supply of energy in the fed state, while mobilization of depot triglyceride provides glycerol and free fatty acids as an energy supply during starvation (Cahill, 1970). Randle, et al, showed that free fatty acids could be metabolised in preference to glucose, at least by some tissues. They suggested that diabetes could be the result of increased production of free fatty acids, the metabolism of which impairs the metabolism of glucose. However, current evidence suggests that the increased mobilization of fatty acids, which is seen in diabetes, is a reflection of relative insulin deficiency and is not in itself the cause of the syndrome.

Steroids like those released from the adrenal cortex in excessive amounts in Cushing's syndrome, produce a state of insulin resistance and precipitates diabetes. Ovarian steroids may do this too.

To summarise, it is clear that there are many ways that failure of the glucose-insulin economy can be brought about. The common factor in all the causes is the eventual deficient production of insulin or its inefficiency in disposing of glucose. Butterfield (1971) grouped the causes which precipitate diabetes, under three broad classifications:

Social factors which are recognised nowadays as precipitating the swing from the tendency toward diabetes to the actual disorder of the metabolism. From epidemiological surveys done in the last decade it is known that diabetes is widespread in the mechanised developed countries, and it is closely associated with ageing, obesity, and to a lesser extent, lack of exercise.

The second group of causes are those conditions which especially precipitate diabetes. These are the endocrinological group of disorders.

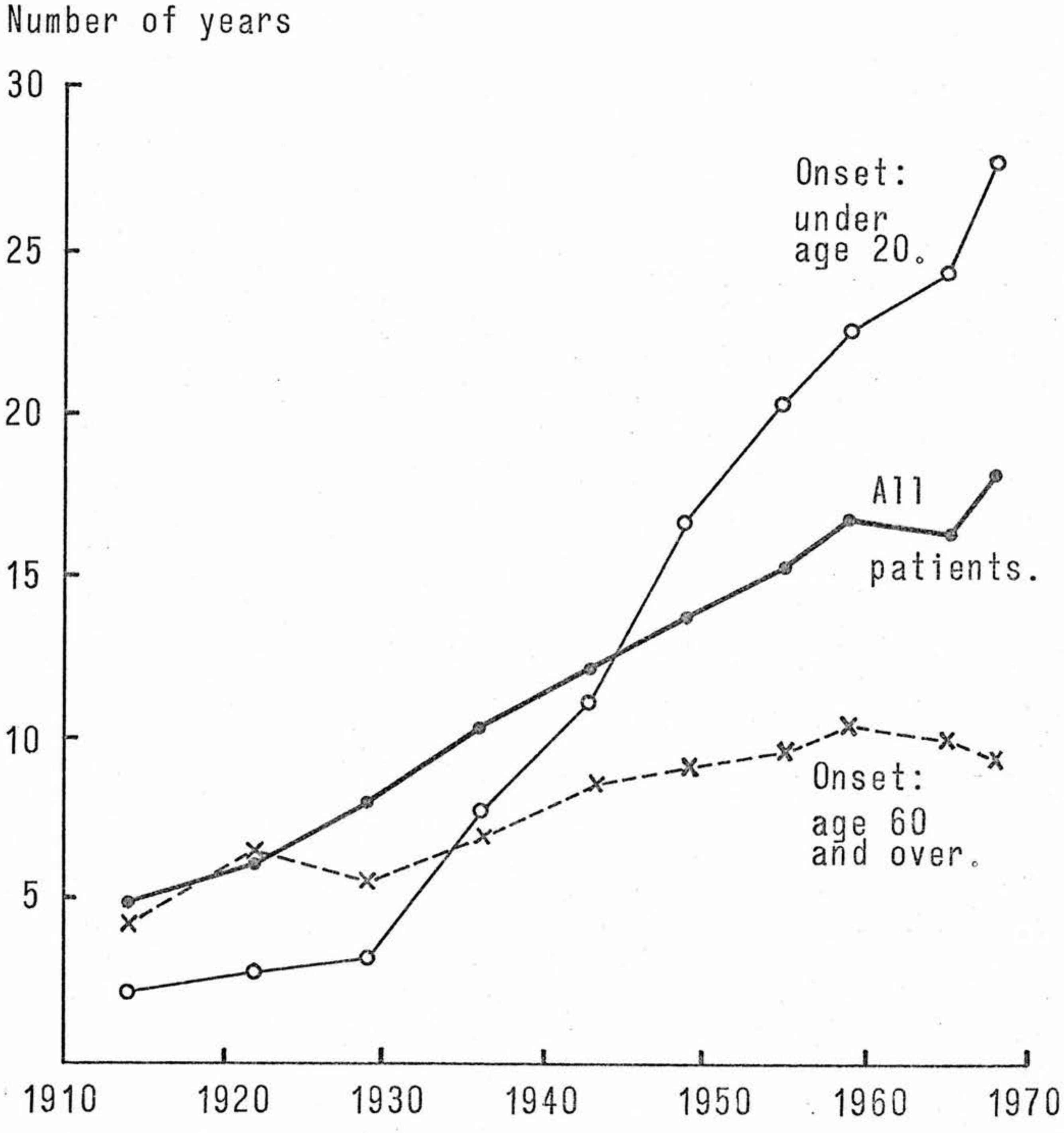
The third group are those concerned with iatrogenic factors. During hospital inpatient care, patients may be found to have abnormal glucose tolerance curves which rapidly return to normal values after discharge from hospital and the re-establishment of normal ambulatory existence. The exhibition of steroid for the treatment of asthma or rheumatoid arthritis and other collagen diseases can also induce a diabetic state. The contraceptive pill can induce carbohydrate intolerance. Recent studies indicated that oral diuretics can induce diabetes by interfering with B-cell function.

Long-term diabetes

When Banting and Best isolated insulin for the first time in 1921, it became possible to treat diabetic ketoacidosis and coma with expectation of recovery. Over the years since then, deaths from diabetic coma have decreased, at first dramatically, and in recent years more slowly. During the period 1960-1966 in the Joslin Clinic series, deaths from coma accounted for only 1.1 per cent of total deaths, in contrast with figures of 63.8 and 41.5 per cent for pre-insulin periods. (Marble, 1971d). By virtue of insulin and later the antimicrobial agents, it has become possible to treat infections in the diabetic with a degree of

Figure 2.

Average duration of life after onset of diabetes.
(based on a study of 27,966 deceased patients of the Joslin clinic.)



urce: Diabetes, proceedings of the 7th Congress of Int. Diab. Fed., 1971, p. 26, Excrepta Medica, Amsterdam.

success which approaches closely that obtained in the non-diabetic person. In the Joslin Clinic experience, deaths due to non-tuberculous infections in the period from 1922 to 1929 accounted for 16.2 per cent, and those due to tuberculosis for 5.5 per cent, of total deaths. In the latest period studied, namely, the three years ending December 1968, non-tuberculous infection accounted for only 5.9 per cent of the 912 deaths reported for that period, and no deaths were attributed to tuberculosis.

Success in the prevention and/or treatment of acute complications has resulted in increased length of life for the insulin-dependent diabetic. The increase in longevity is most marked in those patients with onset of diabetes in childhood. Before the advent of insulin, among deceased patients, the average duration of life in those with onset under the age of 20 years, was only 2.8 years, whereas among those in this age category dying in 1966-1968, the average duration among fatal cases had increased tenfold to 27.8 years (Figure 2). On the other hand, with those whose onset of diabetes was after the age of 60 years, there has been no increase in average longevity during the past two decades.

Priscilla White (1960), from the Joslin Clinic, reported that of 4,774 patients with onset of diabetes under the age of 15 years, 478 had already survived more than 30 years of the disease. Of the 478 survivors, 19 had had diabetes for 40 years or more, and by 1971 this number has grown to about 300 (Marble, 1971d).

This increased longevity has brought with it the problems of generalized vascular diseases. When it became possible for large numbers of young persons with diabetes to live for many years, it was fully appreciated that the susceptibility to coronary, cerebral and renal vascular diseases is much greater than in the non-diabetic individual.

The extent of the excess mortality in diabetics as compared with that of the general population, is shown in Table 13, from the study of Entmacher, et al, (1964).

Table 13: Relative mortality from specified causes among diabetic patients (experience of Joslin Clinic on patients of 1950-1958, traced to 1961, ages 15-74)

Causes of Death	Ratio: Diabetic to general population death rate*	
	MALES	FEMALES
Total vascular disease	2.4	3.4
Ages 15-44	12.2	19.5
Ages 45-74	2.2	3.2
Heart disease	2.0	3.2
Cerebrovascular disease	1.8	2.0
Renal vascular	17.8	17.0
Cancer	1.5	1.6

* Basis of comparison: vascular disease - mortality among white persons in New England, 1949-51; Cancer - mortality among white persons in United States, 1950.

Source: Diabetes, (1964): 13, 377

Although, as the authors have suggested, the comparisons shown in Table 13 are only an approximation because the basic population data which correspond exactly to those for diabetics were not available, it is clear that there is an excessive frequency of cardiovascular disease among diabetics. The disparity for cardiovascular disease is more marked for diabetic femäles than for diabetic males. For all vascular diseases, the mortality for diabetic males is about one and one half times, and for diabetic females about three and one half times that in the general population. At ages 15 to 44 years, the excess is truly great - about 12 times as high among diabetic males, and among diabetic females nearly 20 times as high. For cerebrovascular disease, the mortality among diabetics of each sex is about double that in the general population. Renal vascular deaths show by far the greatest relative excess among diabetics; in both sexes it is about 17 times greater than in the general population. The authors suggested that this reflects the great importance of small vessel lesions among diabetics, particularly among juvenile-onset diabetics with long duration of the disease.

For cancer there is a modest degree of excess mortality among diabetics - about one and one half times that in the general population.

Compiling the various vascular and neurological symptoms, Lundback (1953) showed that frequently these became clinically apparent only twenty years after the discovery of diabetics. Diseases affecting small vessel (microangiopathy) in persons with insulin-dependent diabetes having its onset below the age of 40, are the focus of study in many centres today because of its great impact on disability and mortality.

The most important and disabling manifestation of small vessel disease are retinopathy and nephropathy. In the United States, diabetes ranks third as the cause of legal blindness, affecting in 1962 an estimated 44,660 persons (Diabetes Source Book, 1968). In the United Kingdom it accounts for approximately 14 per cent of newly registered blindness (British Diabetic Association Committee on Blindness, 1971). As for nephropathy, this complication accounts for almost one-half of deaths among persons with onset of diabetes under the age of 15 years (Marble, 1963).

Constam (1970), has shown that the main cause of death was cardiac insufficiency in patients with age at onset of over 20 years, while it was renal insufficiency in those who had the disease before the age of 20. The total number of patients he studied was 781, with diabetes duration of 20-50 years, of whom 623 died.

Permanent incapacity for work in growth-onset (juvenile) diabetes, was due to blindness, nephropathy with oedema, and to hypertension with cardiac insufficiency. While older diabetics are compelled to retire prematurely on account of cardiac or cerebro-vascular insufficiency, gangrene, pre-senile dementia, or severe neuropathy.

Constam had classified his patients according to age, duration, severity of the disease, and different qualities of treatment. It was seen that advancing age and duration, but not severity of diabetes, go along with an increase in neuro-vascular complications. Moreover, there were significant differences between well and poorly treated diabetics in regard to the development of neuro-vascular disturbances, as well as to the duration of diabetes till death. Initially good treatment favours a good prognosis, even in patients treated poorly in later years, whilst bad therapy during the first 5-10 years was seen to cause damage irreparably by later good control. He suggested that by early and good treatment a diabetic has the best chance, but no guarantee of delaying the development of neuro-vascular complications for several decades, and of preserving fitness for work and delaying death. After 30 years of duration of diabetes, seven out of eight well-treated patients had normal fitness for work. The average duration of the disease till death was 20± 13 years in diabetics with good treatment, 16± 9 years in the variably treated group, 12± 9 years in the poorly controlled class.

In the 30 year period up to 1964, over 300 scientific papers, reviews, editorials, and sections of books have appeared which deal primarily with, or contain comments on diabetic vascular disease and its relation to control as judged by the level of blood sugar (Ricketts, 1965). Of 85 studies or reviews representing individuals or groups expressing interest in, or actively conducting investigation in the field, 51 favoured the opinion that poor diabetic control hastens the progress of vascular disease, 26 that vascular disease is not influenced by degree of control, and 8 were undecided.

These clinical studies are almost wholly of a retrospective nature, and were devoted to diabetes in juvenile, insulin-dependent patients, with a duration of 20 years or more. The correlation between degree of control and the presence and extent of vascular complications, is an area in which workers of the Joslin Clinic have been interested for many years, and have published their observations in a series of articles (Keiding, et al, 1952; Marble, 1965;

1966; 1967). These workers led by Alexander Marble (1971a), believe that there is good evidence to suggest that the vascular disease of diabetes is secondary to a metabolic defect, namely, insulin deficiency, and hence early detection and treatment of diabetes is both a logical approach and a responsibility of the physician. They also think that the treatment should not aim at the abolishing of symptoms only, but should also aim at maintaining as good "chemical control" as practicable. They suggest that in this way the vascular complications of long-term diabetes may at least be postponed or minimised.

Their belief that the vascular complications being secondary to the metabolic derangement is supported by the occurrence of retinopathy and nephropathy in non-hereditary forms of diabetes (Bloodworth, 1965). Bloodworth, et al, (1969), and Engerman and Bloodworth (1965) have demonstrated that dogs with non-hereditary diabetes (produced by alloxon and pituitary growth hormone) can and do develop the entire syndrome of diabetic microangiopathy as expressed in the retina and kidney. In man, retinopathy and/or nephropathy have been reported in patients with haemochromatosis (Becker & Miller, 1960), and in those who have suffered extensive damage to, or removal of, the pancreas (Burton et al, 1957; Duncan et al, 1958; MacDonald & Ireland, 1964).

Everyone agrees that in the insulin-dependent diabetic treatment to the extent of avoiding or overcoming ketoacidosis and attendant symptoms is indicated and indeed imperative. However, at this point opinions diverge. The opinion of some, like those of the Joslin Clinic workers, have just been mentioned. Other workers argue that if there are characteristic symptoms, no ketonaemia and ketonuria, one may disregard hyperglycaemia and glycosuria. They believe that angiopathy is an expression of an inherited trait, and is part of the diabetic state. Consequently, control of the metabolic defect cannot be expected to halt the progression of vascular disease.

Their argument is supported by the observation of vascular abnormalities, chiefly thickening of the basement membrane of capillaries that have been reported in persons with potential diabetes (Siperstein, et al, 1968); occasionally retinopathy or other degenerative lesion is present at the time of discovery of diabetes, suggesting that vascular disease may have antedated the metabolic defect. They also argue that it is difficult to demonstrate conclusively the correlation between the degree of control of the metabolic defect and the extent of blood vessel disease.

The argument cited above concerns itself with the process of diabetes and its long-term effect. This process was retrospectively studied in juvenile insulin-dependent patients with a long standing diabetes. Randomised trials were rarely done for the obvious reason of being more difficult to devise and to carry out. Prospective studies of classical type in persons with youth-onset diabetes would be unethical and not in keeping with good medical practice.

Long-term studies among older patients who are not prone to ketosis, and who do not require insulin, would be difficult to assess because of non-diabetic influences which accompany advancing age.

The problem has no easy solution and the diversity of opinion on this subject continues till today, but the volume of articles has decreased somewhat recently, presumably because of the difficulties in designing new and better methods of evaluation. However, the conclusions expressed in two British textbooks on diabetes, give some indication of the current opinion of the majority of workers in this country.

Malins (1968a), in his book, states that "there is probably little to learn from further studies of this kind, but in general they agree that those who seem to have been well controlled have less vascular disease than those who have been poorly controlled." In their text, Oakley, et al (1968), express their belief that "although it is impossible to say in any case that good control will prevent, and bad control lead to complications, nevertheless the incidence of complications is higher in badly than in well-controlled diabetics, and..... good control may be the only factor to which arrest or more rarely, regression of a complication can be attributed."

CONCLUSION

Criteria used for the diagnosis of diabetes mellitus have been questioned as to whether they are based on a natural distribution between normality and diabetes, or whether they represent merely a convenient, but arbitrary dividing line, simplifying the decision for the investigator, but possessing no other validity. The results of population surveys and studies of glucose tolerance test, do not suggest that any natural dividing line can at present be drawn between diabetes and normality in terms of blood sugar level. In the absence of a universally accepted diagnostic criteria other than the level of glucose in the blood, the question of how common diabetes is, remains with no definite answer.

Diabetes mellitus implies glycosuria and urine testing has been used as the means of detection. Its use in this way has indicated a prevalence of diabetes of about 2-3 per cent in affluent societies. However, population surveys (e.g. Bedford and Birmingham, 1962) showed that this is inadequate. Young people frequently have low renal glucose thresholds, and more important, elderly people may have high ones, sufficiently high to conceal relatively high blood sugars.

Blood sugar surveys (e.g. Bedford, 1962) show that there is a very high prevalence of hyperglycaemia, higher than indicated by glycosuria surveys. Among surveys using the same method, the prevalence will also depend on the diagnostic criteria used. For example, on W.H.O. recommended blood sugar levels (140 mgm per 100 ml after 2 hour of glucose loading), Bedford survey showed that 7 per cent of the British adult population might be regarded as diabetic. However, using the level of 200 mgm per 100 ml 2 hour after 50 gm of oral glucose, suggests that the prevalence in the United Kingdom among adults is about 3 per cent.

One notable finding from these surveys has been that there are as many unrecognised diabetics in the community as there are diagnosed cases. However, the unrecognised cases of diabetes discovered during such surveys will only impose a temporary problem on the medical care system. It is only by employing the method used by the survey on a permanent basis that one can hope that the number of unrecognised cases be kept at its lowest possible level. This eventually means that the attitude of the health service should change regarding diabetes surveillance and case detection, toward making it a continuous process, if the aim is to detect and treat the many who would otherwise have continued as unrecognised victims of the disease.

If the aim on the other hand is to measure the frequency of the disease to provide information for the planning of health services for the diabetics, the answer clearly lies in estimating the number of known diabetics in a community.

Diabetics attending hospital clinics have been demonstrated to represent the total diabetic population (Munro, et al, 1949). Moreover, Falconer, et al (1971) demonstrated that diabetes frequency in a community,as estimated from the number of patients attending hospital clinics, is approximately the same as that of known cases obtained from population surveys.

Calculating the annual incidence of new cases diagnosed and/or treated in medical institutions, measures the size of the problem as it represents itself to the health service. It answers the question of the magnitude of the existing problem adequately and in practical terms.

Progress in the past half century in the control of diabetes has exceeded the advances made in the many centuries before. In the first two decades the question of treatment was paramount. There was the hope that insulin might provide an effective response to the disease. But it provided only part of the solution and even then its full benefits were not obtained until advances had been made in the control of infections. In the last two decades attention has turned to the early detection of the disease. The findings of the detection surveys have raised problems which before were concealed. It is probably true to say that there is less certainty in the understanding of diabetes today than there appeared to be when insulin was first isolated.

It became apparent in recent years that diabetes as defined by hyperglycaemia could be caused by many aetiological factors. Although the evidence is still circumstantial that the acute and chronic diabetes syndromes may not represent the same disease process, there is evidence that different aetiological factors may be operating in the two groups. As it has been found that there is no simple genetic explanation for the inheritance of diabetes, environmental factors are probably as important as genetic ones in determining the development of overt diabetes. In childhood and adolescence, environmental factors associated with growth might unmask the tendency towards the development of symptomatic diabetes. Obesity and under-exercising are factors which might precipitate diabetes at any age. Among old persons the ageing processes which disturb protein synthesis (including insulin) might be the responsible factors.

The literature on long-term diabetes and its effect on the development of vascular complication is abundant. It has been shown that the development of such complications is significantly associated with the duration of the disease. Most of these studies observed the vascular complications in patients with long standing juvenile-onset diabetes. However, it is still arguable as to whether or not the control of hyperglycaemia postpones or lessens the development of diabetic complications.

In the following pages we will try to study the patient with diabetes rather than the process of diabetes in a patient. In other words, leaving the long-term diabetes apart, we will try to throw light on the physical, mental, and social wellbeing of the diabetic patient, focusing our attention on his health status at the time of the discovery of his diabetes.

The majority of diabetics are middle aged and elderly people, among whom diabetes is often associated with other diseases and disabilities. To study the extent and degree of this association is probably a profitable and a rewarding approach to the question of diabetic disability and the quality of life of the diabetics.

P A R T   II

THE NEWLY DIAGNOSED DIABETICS

THE NEWLY DIAGNOSED DIABETICS

Introduction

The variations in the reported estimates of the frequency of diabetes, and the factors responsible for these, were described in some detail in Part I. This survey was based on the study of patients attending the Diabetic Clinic at the Royal Infirmary, Edinburgh, for diagnosis and treatment of diabetes. The study group consists of those patients attending the diabetic clinic for the first time during the years 1969-71.

The main objectives in carrying out this study were:

1) To study the frequency of diabetes mellitus.
2) Ascertainment of relationship of diabetes mellitus to social factors.
3) To describe and measure the development of diabetic complications and the association with other diseases among newly diagnosed diabetics.
4) To study the causes of death and other mortality trends of the newly diagnosed diabetics.
5) To permit a discussion of the economic importance of diabetes and the measurement of work-loss days at the time of discovery of the disease.
6) To study the reliability of hospital-collected data.

It should be mentioned that this study is based primarily on data accumulated from patients' clinic and hospital records and therefore, in common with all other retrospective studies, this analysis too, is open to such objections as are applied to those studies. Among the objections is the one concerned with the collection of data regarding clinical entities. The measurement of morbidity is complex and encompasses illness and impairment of varying extent and severity, and in recording of these illnesses much would depend on the examining physicians, among whom the standard of evaluation may differ. The recording of illnesses and impairments might also vary according to the subjective element contributed by the patients.

Description of Methods and Material

The collection of information about the diabetic patients included in this study, was mainly based on information mentioned in the patients' clinical records of the Diabetic and Dietetic Department of the Royal Infirmary, Edinburgh. The clinic of the Diabetic and Dietetic Department was first established in 1924, and is now one of the largest diabetic clinics in the country. The extent to which it is utilised is clearly revealed by two surveys. Cameron, in 1959, conducted the first, in which a circular letter was sent to all general practitioners asking them how they dealt with their cases of diabetes mellitus. 82 per cent of them said that they sent any case of whatever nature to the Diabetic Department of the Roual Infirmary, Edinburgh. The remainder sent their cases to the hospitals of the area, mainly to the Western General Hospital, Bruntsfield Hospital, and the Royal Hospital for Sick Children. Only 4 out of 400 general practitioners dealt with some cases of diabetic mellitus by themselves within their own practices. An equally small proportion sent some of their patients to private consulting practitioners. In a more recent study, Falconer, Duncan and Smith (1971), in order to report the age-specific prevalence of diabetes mellitus in Edinburgh, prepared a list of names of persons with diabetes, alive and in Edinburgh at 1 January, 1968.* Out of 3143 patients thought to be alive and resident in Edinburgh, 2512 (79.9 per cent) were attending the Royal Infirmary's Diabetic Department, having current clinical files in that Department. The number of diabetics from other hospitals in Edinburgh was 437 (13.9 per cent) patients; 150 (4.8 per cent) patients consulted general practitioners only.

Patients attending other hospitals will be shown in this study to have an age-sex distribution similar to those attending the Royal Infirmary clinic. There is as yet no evidence to suppose that they are attending the other hospitals for any reason other than the geographical distribution of their homes.

Patients who are not referred to hospitals, and are kept under the supervision of their general practitioners, usually have mild diabetes and are older. This also was demonstrated by Falconer, Duncan and Smith (1971). Because of a generally increased awareness concerning diabetes, and a more specific local awareness created by the 1968 study of the Diabetic Department, when 263 general practitioners were contacted and asked about patients with diabetes in their practices, it is thought that the number of diabetics who are not referred to hospitals from general practices is getting less nowadays. Patients with mild diabetes

* To prepare the list they used hospital records and enquiry made of general practitioners.

would now be referred at least once to the hospital, usually to treat the other pathology which brought diabetes to light. The control of this mild diabetes would be the responsibility of the general practitioner thereafter, with reference back to the diabetic clinic if the necessity arises. However, the exact number of those few patients who will not be referred at all to a diabetic clinic is difficult to ascertain, because general practitioner files are not always suited to searches for diabetic patients. The searches therefore could not be very thorough, even if such a search was done. In order to get some idea of the magnitude of the problem of the newly diagnosed diabetics who are not referred to a diabetic clinic, we undertook to interview two general practitioners who have a special interest in diabetes and with a proportionally large number of diabetics on their list. Both general practitioners stated that not referring a diabetic patient to a diabetic clinic is a very rare practice these days. But they thought it could happen once in 1-2 years in their own practices. They also agreed, speaking generally, that it is the practice in recent years among general practitioners to send all patients to a diabetic clinic at the onset of their illness to establish the diagnosis.

As far as one could judge at the time, a survey made using the patients attending the Royal Infirmary, Edinburgh, would be deficient in some of the young patients attending the Royal Hospital for Sick Children, and also in representatives of the wealthier sections of the community attending private consultants. However, the number of patients attending private practices is thought to be small and is also difficult to determine. Most of these patients usually attend the clinic at time of diagnosis of their illness, after which they would be transferred to a private consultant. Our survey included 4 such patients.

It seems therefore, that we are probably left with a small deficiency of the younger sections of the community in this study, but there is no reason to suppose that this would unduly vitiate the results obtained from it, especially if one knows that the majority of patients attending the Royal Hospital for Sick Children would be referred to the Royal Infirmary clinic once they had attained the age of 16 years. Patients in the younger age group in this study include all those who were referred in this way during the years 1969-71.

The patients on whom the present study was based had come to the Diabetic Clinic of the Royal Infirmary, Edinburgh, for treatment and diagnosis of diabetes during the years 1969-71. In order to have the chance of working closely with the clinicians and getting to know the various kinds of definitions and criteria used in the diagnosis and management of diabetes, I worked in the clinic as a clinical assistant from the commencement of the study early in 1972, and have performed clinical duties in addition to the collection of data for the study. This enabled me to record the collected data from patients' records as accurately as possible. I saw many of the patients on whom the study was based when they attended the clinic for their scheduled appointments.

The Diabetic Department keeps a main alphabetical index of all the patients who have ever attended the clinic. On this index the following data are listed for each patient: Name; Address; Date of birth; Date of first attendance; The diagnosis, e.g. diabetes mellitus, obesity. The main index is divided into three parts: one part for those patients currently attending the clinic, one for patients who have defaulted from attending for two or more years, and the third is for patients who have died.

There is another index which is in the form of a notebook, renewed annually, to list by name all the patients who attend the clinic in any particular year. This "Annual" index records beside the name, the diagnosis and the particular date each patient first attended the clinic.

All the records, of all the patients on the annual index who attended the clinic for the first time in the years 1969, 1970 and 1971, were examined. Information was extracted for all the patients in these years who were Edinburgh residents*(1116 patients). Of these, 776 were diabetic and the other 340 were not diabetic but were referred to the clinic to verify the suspected diagnosis of diabetes. They were proved not to be suffering from the disease by studying their medical history, clinical examination, and the

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* Living within the 23 Edinburgh City wards:-

1. St.Giles
2. Holyrood
3. George Square
4. Newington
5. Liberton
6. Merchiston
7. Morningside
8. Colinton
9. Sighthill
10. Gorgie and Dalry
11. Corstorphine
12. Murrayfield and Cramond
13. Pilton
14. St. Bernards
15. St.Andrew
16. Broughton
17. Calton
18. West Leith
19. Central Leith
20. South Leith
21. Craigentinny
22. Portobello
23. Craigmillar

(Edinburgh and Leith Post Office Directory, 1971-72, p.418) results of standard glucose tolerance tests. All the patients of the study group (1116) were followed up, and information was recorded about them until 31 December 1972, when the observation period ended.

Exclusion from the study of those patients living outside Edinburgh* was decided upon because they were scattered throughout the country, mainly in the South-Eastern region of Scotland; their attendance at the clinic was not in the same frequency as those who lived in Edinburgh, and, indeed, they seldom attended the clinic after their first attendance. Information about them regarding hospitalisation, and trend of other diseases among them will be incomplete. Some of these patients were referred, after their first attendance, to one of the "peripheral clinics". These clinics were run by the staff of the diabetic clinic of the Royal Infirmary. One peripheral clinic is in Dunfermline; another is in Haddington, and a third is in Galashiels. Some other patients not living in the above areas but living at a considerable distance from Edinburgh, would usually be supervised by their general practitioner or by the local hospitals in their area of residence. They would be referred to the Royal Infirmary clinic only when the need arises. This means that those patients who are referred to the Royal Infirmary from areas outside Edinburgh are

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* 20 patients were excluded from the study although they were Edinburgh residents. The reason for this was that for 2 patients there was no data to indicate that they were diabetics and their central medical records files did not indicate that they were diabetics. In 9 patients the diagnosis was made before 1969, and attended the clinic only once to obtain specialist opinion regarding management. They were referred by physicians in other hospitals to whom they were referred back. In the other 9 patients, the exclusion was because they were not diabetics. Diabetes was ruled out by history-taking and a random blood sugar estimation.

more ill than other diabetics from the same areas who are not referred to the Royal Infirmary. Consequently, if they were included in the study they could constitute a biased sample. Other patients were living in other parts of Scotland or in England or even outside the United Kingdom, and came to the clinic once or twice while they were on a visit to Edinburgh, or while spending an academic year in the University of Edinburgh. Information about all these patients for all the period of observation was incomplete and, were they to be included, the average number of attendances, admissions to hospitals, morbidity and mortality among all the study group would be under-estimated. Calculations of the disease frequency among the general population, and morbidity and mortality rates among diabetics, would be incorrect.

Information derived from patients' records in the diabetic clinic relating to the study group of 776 diabetic patients, was examined more than once before consulting the master index of the Royal Infirmary of Edinburgh. This index is kept in the Central Medical Records Department of the hospital. Its consultation and the examination of the inpatients' records were made to complete information which was lacking on some of the patients in the study group, e.g. their marital status, occupation, and their hospital-isation periods. In this way we were also able to obtain information about those patients for whom the diabetic clinic records were either missing (2 patients), or contained no data (2 patients). Thus, for all known diabetics who attended the diabetic clinic for the first time in 1969-71 (776 patients), all but one were included in the study, and the data collection sheets numbers 1 and 2 were completed for 775 patients (see Appendix A). The remaining patient was not included in the study because his clinic record contained no data apart from the result of a glucose tolerance test, which showed that he is a diabetic. He had no records as an inpatient, and later he was discovered to be attending a private consultant.

Copies of the Scottish Hospital In-Patient Statistics (Index of Diagnosis and Operation, available to hospital authorities from S.H.H.D.) for the years 1969-72 inclusive, were obtained for all the general hospitals in Edinburgh, including long-term geriatric hospitals and the Royal Hospital for Sick Children. If any of these hospitals keeps a diabetic patients' index, this also was consulted for the 1969-72 period. The diagnostic category of diabetes mellitus on the statistical returns were examined for all the hospitals. The inpatients' records of all patients in this category were examined carefully in each of the hospitals concerned, and for all the years under investigation.

This exercise was performed to enable us to ascertain and complete the number of the annual incidence of diabetes mellitus in Edinburgh. The number of patients collected from all other hospitals, who were newly diagnosed during the years 1969-71, was 277. These patients were Edinburgh residents and their diabetic control was looked after by other hospital, and were not referred to the diabetic clinic of the Royal Infirmary. Only basic data concerning their age at diagnosis and sex distribution was collected about them.

The information from this exercise proved also to be very valuable in ascertaining and checking the information about those diabetics on the study group who have been admitted to any of the hospitals studied in Edinburgh during the four years of observation. The collected information was useful, especially about causes of admission, length of stay, and sometimes about topics like marital status and occupation, when these were unknown. The identification of those patients who are in the study group and who have been admitted to other hospitals during the observation period, was by a process of checking the inpatient hospital statistics for each hospital in each year, with the main index of the diabetic department. Those names which appeared on the index were then checked with the list of names in the study group. Thus, information about the study group was verified and duplication of patients for the purpose of counting the annual incidence was avoided.

Interviewing of patients

Patients were interviewed in order to discuss the effect that diabetes and other diseases has on the diabetic's way of life, in terms of his working capacity and limitation of activity; also, to test the reliability of the hospital's collected data. Patients from the study group were interviewed at their homes personally by the author. The interviewing of patients was done in the first quarter of 1973. The interview group of patients included all the diabetic patients who first attended the clinic in 1971 (282 patients). Of these, 247 were visited and interviewed, 2 were contacted and replied by letter, and for the total number of 249, data collection sheet number 3 was filled in (Appendix A). Of the remaining 33 patients, 29 were dead (24 died during 1971-72, and the other 5 during the first quarter of 1973). Another 4 patients were not interviewed for the following reasons:

1) imprisoned in London;

2) moved to Inverness in January 1973 and failed to reply to letters;

3) mentally handicapped patient, resident in Gogarburn Hospital;

4) refused to co-operate.

Remembering the fact that the subjective element of any disease is difficult to ascertain, or will be incomplete, and that the patient's memory of events in the past may be faulty, the information about the 249 patients interviewed after being collected, was checked with the information collected about them from diabetic clinic records, inpatient records of the Royal Infirmary of Edinburgh, and the Scottish In-Patient Statistics for all the hospitals in Edinburgh. The 1971 group of patients was chosen to be interviewed because they would be easier to trace, change of addresses would be less than if either the 1970 or 1969 groups were chosen, and it would be easier for the patient to recall events that happened during 'last year', than to recall events as far back as, for instance, how many days he or she had spent in bed because of illness three years ago. The time factor would hardly operate on recording the complication or disease present at time of interview for the newly diagnosed diabetes in the 1971 group.

Information about the dead patients

96 patients out of the 776 diabetic patients died during the observation period (from their first attendance in 1969, 1970

or 1971 until 31.12.72). In the case of 69 of the dead patients, the death was mentioned in the diabetic clinic's records. The Registrar General's Office in Edinburgh was consulted to obtain copies of the death certificates. Information was extracted from both patient's clinical record and the death certificate, and recorded in the data collection sheet numbers 1 and 2. To give reliable estimate of the mortality among newly diagnosed diabetics, and to be certain about the status of patients at the end of 1972, a list of patients' names was constructed for those patients who had not attended the clinic during the last six months of the observation period (second half of 1972), and/or were suspected of having died of old age or grave illness. This was done for patients who first attended the clinic in 1969 and 1970. The list of (186) patients' names, addresses and ages was checked against the death index in the Registrar General's Office for the years 1969, 1970, 1971 and 1972. As a result of this, 17 patients were discovered to be dead. Their death certificates were consulted. The interview study discovered, on visiting their homes, that a further 10 patients had died. Their death certificates were also obtained and examined. Another 5 patients from the interview group were discovered by the survey to be dead after the end of the observation period (i.e. died in first quarter of 1973) but they were not included in the analyses made on the dead patients.

Table 13a: Source of referral and ultimate diagnosis of 1115 patients who first attended during 1969-71, Diabetic Department, Royal Infirmary, Edinburgh

DIAGNOSIS	MALES			FEMALES			BOTH SEXES			Total	
	"In-patient"	"Out-patient"	"G.T.T."	"In-patient"	"Out-patient"	"G.T.T."	"In-patient"	"Out-patient"	"G.T.T."	No.	%
Newly diagnosed diabetics	38	196	65	54	269	50	92	465	115	672	60.3
Known diabetics	5	46	-	8	44	-	13	90	-	103	9.2
Non-diabetics	-	-	213	-	-	127	-	-	340	340	30.5
Total	43	242	278	62	313	177	105	555	455	1115	100.0

Criteria for referral and ultimate diagnosis of patients first attending the diabetic and dietetic department during the period 1969-71

During the period 1969-71, 1115 patients were referred to the Department because they had been either previously diagnosed to be, recently diagnosed, or thought to be diabetic.

Table 13a shows the details of the source of referral and ultimate diagnosis.

Of these, 103 had been previously diagnosed diabetics but started attending the department in 1969-71 period. 672 were diagnosed to have the disorder during the 1969-71 period and 340 suspected as being diabetic on referral, but as the result of a glucose tolerance test they were found not to be suffering from this disorder.

The 299 men and 373 women who, as the result of referral had been diagnosed diabetic, received appropriate advice and treatment and continued, in the main, to attend the department for follow-up at appropriate intervals.

Of the 103 (51 men and 52 women) known diabetics referred to the department during 1969-71, 98 had been discovered to be diabetic before 1969. Of the other 5 patients, 4 were diagnosed elsewhere as being diabetic in 1969 and one in 1970, but had been referred to the clinic only during the period 1970-71. These 5 patients are thus considered as being newly diagnosed, and for the purposes of the study in relation to calculation of the annual incidence rate for the years 1969-71, added to the 672 patients "newly diagnosed to be diabetic" during this time.

The 1115 patients have been analysed in regard to source and cause of referral. Of these, 105 were referred to the clinic because they had been admitted to hospital for non-diabetic reasons through the Royal Infirmary. Of these, 13 (12.4 per cent) were previously diagnosed diabetics, whereas in the case of the other 92 (87.2 per cent) the diagnosis of diabetes was established for the first time when they were in hospital. All were, prior to discharge, referred to the outpatient department for appropriate instruction in diet, oral hypoglycaemic or insulin therapy.

555 (242 men and 313 women) were referred to the department as outpatients by their general practitioner, or more rarely by another hospital or other medical institution. In 465 (83.8 per cent) of these the diagnosis of diabetes was suspected either because of typical diabetic symptoms associated with the finding of glycosusia or the discovery of the latter during routine medical examination for another complaint. The diagnosis of diabetes was confirmed at the patient's first visit to the diabetic department by the finding of a random capillary blood glucose level (usually two hours post-prandial) - measured by the autoanalyser blood glucose technique - in excess of 200 mgm per 100 ml.

In the other 90 (16.2 per cent) outpatients the diagnosis had already been established prior to their first attendance at the department. 86 had been known to be diabetic prior to 1969, three were diagnosed in that year, and one in 1970.

With very few exceptions patients referred to the department were initially seen on purely clinical grounds and no previous arrangement for a glucose tolerance test had been made. The latter was carried out when the mid-morning blood glucose value was of doubtful significance 120-140 mgs per 100 ml; there were symptoms suggestive of diabetes despite a normal mid-morning blood glucose value (usually in patients who had adhered to a restricted carbohydrate diet for a couple of weeks previously), or the patients discovered to have glycosuria by Clinistix during examination for insurance or other similar purposes. 455 patients who had glucose tolerance test were referred as "outpatients". However, the "G.T.T." group was separated from the "outpatients" to demonstrate the total number of patients who had the test. The number of "inpatients" who had glucose tolerance tests cannot be ascertained. It is clear that patients referred to the Diabetic Department as having been newly diagnosed as diabetic, after admission to hospital, by glucose tolerance test, rather than by symptoms of "spot" blood sugar, was very small indeed - only 1 patient of the 115 patients so diagnosed was an "inpatient". All patients found to have glycosuria on admission to the Surgical, Obstetric, Ophthalmological and other "non-medical" wards were immediately referred to the diabetic department for further investigation. This rarely included a glucose tolerance test.

445 patients were given 50 gm oral glucose tolerance test; of these, 340 (74.7 per cent) showed no diabetic abnormality and were thus diagnosed to be "non-diabetic". The other 115 patients (25.3 per cent) subjected in the diabetic department to a glucose tolerance test (because the spot blood sugar value was not in excess of 140 mgs per 100 ml mid-morning, there were no diabetic symptoms or other suggestive criteria of diabetes), did in fact

show abnormal glucose tolerance. The criteria for diagnosis of diabetes were those recommended by the Medical and Scientific Section of the British Diabetic Association (Fitzgerald & Keen, 1964).

Table 14 shows that the diagnosis of diabetes in the confirmed 775 patients was suspected most commonly by the patients' general practitioners (438 patients). Hospital wards and outpatients' departments suspected the presence of the disorder in 325 patients. 185 patients out of the 426 who were above the age of 60, were first suspected of having diabetes while they were in a hospital or attending an outpatient department of one.

Table 14: Suspicion of diabetes in 775 confirmed cases 1969-71

Diagnosis was suspected by:	All ages	<40	40-59	60+
General practitioner	438	66	137	235
Hospital departments	325	55	85	185
Insurance examination	10	1	5	4
Patient	2	0	0	2
Total	775	122	227	426

Patients referred to the department for the first time are usually seen either by a Consultant or Registrar/Senior Registrar with special experience in this specialty. The patient's history is carefully taken, appropriate specific questions with regard to diabetic symptomatology elicited, full examination carried out, including urine test for sugar and albumin, blood glucose* (result available by autoanalyser technique within 10 minutes), weight, height and full clinical examination including fundus check under mydriasis. Urine tests are carried out by Labstix originally, and, if positive, by Clinitest.

Patients established on the above grounds as having diabetes mellitus are treated with diet, diet plus oral hypoglycaemic agent, or admitted to hospital for education in the principles of diabetic self-regulation with diet and insulin. The technique used is a "team" one involving dietitian, nurse, and doctor with equal responsibilities.

Newly diagnosed diabetics considered "controllable" by diet alone, have the nature of their disease and the reasons for dietary restriction adequately explained to them by doctor and dietitian, are instructed in the technique of home urine testing by Clinitest, and asked to test 1-3 times daily (according to

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* The autoanalyser used in the Diabetic Department employs the gualacum method for blood glucose estimation utilising a glucose oxidase "Specific" technique. The principle of the test is: glucose is oxidised in the presence of glucose oxidase to gluconic acid and hydrogen peroxide which, in the presence of peroxidase, reacts with gualacum to form an intense blue colour. The intensity of this will be recorded after passing through a colorimeter.

Labstix is a reagent strip to test for ph, protein, glucose, ketones, and blood in the urine, all at one time. All estimations are semi-quantitative. Protein estimations ranging from trace to over 1000 mgm per 100 ml.

Clinitest: the tablet consists of copper sulphate, sodium hydroxide, sodium bicarbonate, and citric acid. The test is a quantitative one (up to a concentration of 2 per cent) based on the reduction of copper sulphate by any reducing substance present in the urine to cuprous oxide. Thus the test is not specific for glucose.

Clinistix: A cellulose strip, containing glucose oxidase, peroxidase and chromogen system, is dipped briefly in urine and the colour observed 10 seconds later. A purple colour indicates the presence of glucose. This test is specific for glucose, but it gives a semi-quantitative measurement of its presence.

whether "fair" or "strict" diabetic control is desired [Duncan, 1966]), the appropriate urine specimens at home for sugar on two or three days a week, and to report thereafter in a month's time. Patients with very appreciable symptoms, 2 per cent glycosuria, and a blood glycose in excess of 250/300 mgs per 100 ml, are (unless very obviously obese) usually started off on an appropriate dose of sulphonylurea with instructions to reduce the dosage should the overnight urine specimens become negative. In general, they are asked to report back to the clinic in two or four weeks time when alterations in therapy can be advocated. Symptomatic diabetics under the age of 30, and other obviously insulin dependent diabetics, are admitted to the ward for five or seven days in order to be taught the principles of diabetic self-control with insulin and diet. Whatever the form of treatment the patient has of necessity to understand the principles involved and be made abundantly aware of the fact that the responsibility for control of the diabetes is his or her responsibility. The latter statement implies of course, adequate education, which is the keystone upon which the diabetic clinic at the Royal Infirmary is based.

Needless to say the general practitioner is kept informed by letter of the instructions given to the patient, since his role in the day to day care of the diabetic patient is essential to the smooth running of such a large department.

Table 1 in Appendix shows that 455 patients referred to the department during the period of study, had glucose tolerance tests carried out. The principal reason for suspecting the diagnosis of diabetes was the random discovery of glycosuria. In the case of 60.8 per cent of males and 46.3 per cent of females this was determined during the course of medical examination; in 32 males and 23 females glucose tolerance test was carried out because of glycosuria associated with infection, trauma, surgery, steroid therapy or myocardial infarction, and in a further 33 females the glycosuria was associated with pregnancy. In 34 men and 4 women the glycosuria was discovered during insurance examination. Altogether, the test was done because of the finding of glycosuria in 235 of 278 (84.5 per cent) males, and 142 of 177 (80.2 per cent) females.

Other causes of referral for glucose tolerance testing were apparent symptoms of diabetes (81 patients), family history of the disorder (51 patients). and in 43 patients the discovery of glycosuria by the family doctor was eventually attributed to hyperthyroidism and other endocrinological diseases, and in 20 patients to gastro-intestinal (e.g. partial gastrectomy) or liver disease. In 23 patients the cause was the complaint of hypoglycaemic attacks; in another 9 patients there were signs suggestive of diabetic retinopathy or neuropathy.

The glucose tolerance test was carried out on 455 patients because at the time of first referral to the diabetic department the diagnosis of diabetes could not be established on the basis of symptomatology, significant glycosuria in a random mid-morning urine specimen, or a blood glucose value in excess of 200 mgs per 100 ml at that time. In the case of patients aged over 60 who had no diabetic symptoms, who, on the instructions of their general practitioner had for at least a week previously restricted carbohydrate and had a random blood glucose of from 120-160 mgs per 100 ml, the glucose tolerance test was performed a week later after consumption of "normal carbohydrate containing diet".

The patient first attended the clinic in a fasting state. A fasting blood sugar value of 140 mgs per 100 ml was taken to indicate diabetes, but in many cases the value was considerably less than this, in which case either a standard glucose tolerance test was carried out or,in the case of older patients, a blood glucose was obtained two hours after they had taken a high carbohydrate containing breakfast, a week or so later. A blood glucose value of 140 was taken then to indicate the presence of diabetes.

The glucose tolerance test was carried out in the department in the normal way. Patients were given earlier an instruction sheet indicating that they should eat nothing after their main evening meal on the previous night, take only a cup of tea without sugar or milk at breakfast, arrive at the clinic at about 9 a.m. without having indulged in undue exertion previously. The test was carried out in the sitting position, and each patient was allowed to rest for 15 minutes or so before taking 50 gms of glucose by mouth in the form of 200 cc chilled 25 per cent solution in lemon flavoured water. Previously, a fasting urine sample had been obtained, and a fasting capillary blood sample collected from the thumb. Similar samples were obtained at $\frac{1}{2}$, 1, $1\frac{1}{2}$, 2 and very often $2\frac{1}{2}$ hour after the intake of glucose, and on some occasions when post-prandial hypoglycaemia was being looked for, the test was extended to 4 or 5 hours.

Blood glucose was determined by the autoanalyser using the glucose oxidase method with gualacum as the indicator. The withdrawal of capillary blood is more convenient to the patient, rather than obtaining venous samples, and in addition can be done by an experienced technician and does not require the services of a doctor. In addition, the renal excretion of glucose is more related to the capillary than venous blood glucose concentration.

In interpreting the test the upper limits of normal for capillary (whole) blood glucose in the above tests were for persons aged under 50 years: fasting 110, ½ hour 180, 1 hour 160, 1½ hours 150, and 2 hours 120 mgs per 100 ml. If any of these values were exceeded (and one of these had to be the 2 hour), then diabetes was accepted. In several instances the fasting blood glucose was within normal range but the others were excessive.

In the case of patients aged 65 or over, the corresponding lower limits of normality were 120 mgs per 100 ml fasting, and at ½, 1, 1½ and 2 hours , 200, 180, 160 and 140 respectively.

Since factors other than age alone may affect glucose tolerance, care was taken to ensure that the patient had previously consumed an adequate diet, did not move about or smoke during the test, was not in receipt of drugs with "diabetogenic" properties, and was not hyperthyroid. Other conditions which affect the test are: obesity, hypertension, acromegaly, pregnancy, cancer, chronic neurological diseases, cerebro-vascular accident, and acute myocardial infarction.

In some instances it was not possible to interpret the glucose tolerance test because it showed only a marginal result,

Table 15: Results of G.T.T. in 455 patients according to age and sex, Diabetic Department, Royal Infirmary, Edinburgh 1969-71

	ALL AGES						<20		20-39		40-59		60-79		80+	
	Both Sexes		Males		Females											
	No.	%	No.	%	No.	%	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
Normal Curve	165	36.3	93	33.5	72	40.7	11	9	25	30	39	20	16	13	2	-
Renal Glycosuria	123	27.0	81	29.1	42	23.7	6	2	32	31	31	7	12	2	-	-
Diabetic Curve	47	10.3	21	7.6	26	14.7	1	-	2	4	13	9	5	12	-	1
Diab.Abnormalities	66	14.5	43	15.5	23	13.0	1	2	1	-	16	7	23	14	2	-
Other Abnormalities	54	11.9	40	14.4	14	7.9	2	2	11	5	16	5	11	2	-	-
Total	455	100.0	278	100.0	177	100.0	21	15	71	70	115	48	67	43	4	1
Change to Diabetic curve	3		2		1		1	-	1	-	-	-	-	1	-	-
Reversion to normal curve	2		2		-		-	-	1	-	1	-	-	-	-	-
Total Diabetic	115	25.3	65	23.4	50	28.2	3	2	3	4	29	16	28	27	2	-

or the results were indicative of some technical discrepancy in which case it was repeated after an appropriate time interval.

The glucose tolerance test results derived from the patient's records are listed in the appropriate categories on the data collection sheet No.1 (column 74 to 76 - "Appendix A").

In clinical practice no such classification of patients is necessary but was carried out for interpretative purposes in this study. There is, of course, a wide variation in glucose tolerance within the population (affected by factors which have previously been mentioned), and it is a matter of debate to define what is the upper limit of "normal". Thus there were patients whose glucose tolerance appeared to be slightly impaired, but in whom no decision could be taken at that time as to whether or not they should be regarded as being diabetic or potentially diabetic. Because of this, and to avoid the use of such terms as "G.T.T. positive" and "G.T.T. negative" or "diabetic G.T.T." and "normal G.T.T.", the results of the tests have been categorized as indicated in Table 15, which shows the results of the tests done on the 455 patients, according to age and sex.

165 (93 males and 72 females) had a definitely normal curve in that no glycosuria was detected in any specimen using Clinitest, and that all blood glucose values were below the upper limit of normal fasting and at each half-hourly interval thereafter as defined previously.

Of these 165 patients, 117 (68 males and 49 females) (Table 2 in Appendix) were referred to the clinic because glycosuria had been incidentally discovered almost always by use of Clinistix, which, although widely used in general practice and in hospital departments, and has the advantage of being specific for glucose, is "over-sensitive" and could give false-positive results in that it gives a positive reaction when glucose is present in concentrations as low as 15 to 40 mgm per 100 ml of urine; the latter frequently occurs in normal persons, especially post-prandially (Fine, 1965). Normal urine contains glucose in very small amounts, 1-15 mgm per 100 mls.

In young people, about 12 per cent of males pass more than 15 mg glucose per 100 ml urine, as do about 4 per cent of females (Pyke, 1968a). On the other hand, the Clinitest, although not specific for glucose, is much less sensitive and normally only gives a positive result if a reducing substance is present in concentrations of more than 150 mgm per 100 ml urine.

Renal glycosuria was defined as being the presence of glucose determined by Clinitest in any of the urine samples obtained during the glucose tolerance, although none of the blood glucose values exceeded the normal.

123 of 455 patients (27 per cent) had renal glycosuria so defined. It was commoner among males than females, being present in 29.1 per cent of males and 23.7 per cent of females (Table 15). Moreover, it was more frequently found in younger than older persons. Thus in age group 20-29 years, 45.1 per cent and 44.3 per cent of males and females respectively had renal glycosutia, whereas in those aged from 60-79 years it was found in 17.9 per cent of the males and 4.5 per cent of females. Thus the renal threshold for glucose in general is lower in males than in females, and

although the threshold appears to increase with age, this discrepancy between sexes persists. This accords with the result of the Bedford Survey (Butterfield, 1964), which showed that the renal threshold for glucose rises with age and at each age group is higher in the case of women than men. In that study, 25,000 persons were randomly selected from the population for post-prandial glycosuria. When present it was due to a low threshold in over 90 per cent of those aged 20-29, thereafter declining with age.

In the present study 33 women were referred because glycosuria had been discovered during pregnancy. Glucose tolerance testing showed that of these the glycosuria was due to a low renal threshold in the case of 27 (81.8 per cent). In the case of the other 6, diabetes was judged not to be overtly present on the basis of the blood glucose readings (Table 2 in the Appendix).

Glycosuria often occurs in normal pregnancies, especially during the second and third trimester, but usually only traces of sugar are found and many specimens may be negative. In 1,000 pregnant patients attending Kings College Hospital Ante-natal Clinic, glycosuria was found by Clinistix at some stage in their pregnancy in 9 per cent (Pyke, 1968a). It was rare before the twentieth week of gestation, but reached the peak incidence at 30-34 weeks. It is not known whether the lowered threshold of pregnancy is due to defective tubular absorption of glucose or to increased glomerular filtration. Clinistix, having the advantage of being specific for glucose is useful for screening pregnant women for diabetes, since lactosuria, which is not uncommon in late pregnancy, does not affect the test. However, because of its undue sensitivity, a positive Clinistix reaction should be checked by Clinitest.

Patients who had an abnormal glucose tolerance test response were divided into three categories, those showing a definite "diabetic curve" (47 patients); those showing "diabetic-like abnormalities" (66 patients); and those who showed "other abnormalities" (54 patients). Patients of the third category were not diabetics. However, three of them progressed to show "diabetic curve" during the follow-up period (Table 15).

1. 47 patients (21 males and 26 females) were found by the glucose tolerance test to be inarguably diabetic.
2. In 66, diabetic-like abnormalities were present and were sub-divided according to the result of the test into the following (See Table 3 in Appendix):

   In 54 (36 males and 18 females), although the fasting value was below 110 mgs per 100 ml, the blood glucose values at 1, $1\frac{1}{2}$ and 2 hour exceeded the upper limit of normal.

   In 8 (5 males and 3 females) the 2 hour figure was excessively high, whilst the values at 1 hour and fasting were normal (1 of these was a male patient who was 16st in weight and after satisfactory dietary treatment and weight loss in the subsequent four months, the curve had returned to normal).

   4 (2 males and 2 females) had normal fasting and 2 hour values, although the intermediate readings were well in excess of the upper limits of normal.

It should be noted that the above 66 patients, considered to have "diabetic-like abnormalities", in none of them did the fasting blood glucose value exceed the normal limit.

3. 54 patients showed "other abnormalities", and were sub-divided according to the result of the test into: (See Table 3 in Appendix).

3 (1 male and 2 females) showed rapid alimentary absorption with high values, at $\frac{1}{2}$ and 1 hour with very low values at 3-4 hours of less than 50 mg per 100 ml. One of these had a positive family history, 2 had hypoglycaemic symptoms, but at the end of the period of observation none of the three had become diabetic although still being kept under observation.

45 patients (35 males and 10 females) showed a curve with abnormally high values at $\frac{1}{2}$ and/or 1 hour only without any subsequent "hypoglycaemia".

This curve may be due to rapid absorption of carbohydrate such as in active peptic ulceration, partial gastrectomy or gastrojejunostomy, and in patients with hyperthyroidism. There is also a suggestion that this so-called 'lag-storage' curve may be found in hepatic sclerosis. 8 out of 17 men and 1 out of 3 women who had a history of gastro-intestinal diseases, showed such a curve (Table 2 in Appendix).

Of the 45 patients, 2 eventually developed overt diabetes and 1 reverted to normal curve*. In the Birmingham survey

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* The glucose tolerance curve of a 17 year old boy with glycosuria and family history of diabetes had changed from "high $\frac{1}{2}$ and 1 hour" to a "diabetic curve", with frank diabetes symptoms after a period of 6 months. A 33 year old man came with glycosuria, and his curve showed "high 1 hour", but on retesting after 1 year, showed "high 1 and 2 hour" curve, and the patient complained of typical diabetes symptoms. A 54 year old man with hyperthyroidism and glycosuria, showed a curve of high $\frac{1}{2}$ hour". After successful management of his thyroid disease, the glucose tolerance curve returned to normal.

79 patients with the 'lag-storage" curve were re-examined five years later and of these only 2 had become frankly diabetic (Fitzgerald, 1966).

In the remaining 6 patients (4 males and 2 females) the glucose tolerance test result showed minor deviations which were not considered to be of significance in view of the patients' advanced years (3 were above the age of 70, 1 above 60, and 2 above 50 years). They did however, report to the clinic at yearly intervals and one of them, a lady of 76 years, was found 18 months later to have a 2 hour post-prandial glucose of 220 mgs per 100 ml, and definitive diabetic symptoms.

115 (25.3 per cent) patients out of the 455 patients tested were thus considered as diabetics. The diagnosis of diabetes (diabetic curve and diabetic abnormalities) was commoner among women (28.2 per cent) than among men (23.4 per cent). It was also commoner among older patients than among the young. 4.2 per cent of men and 5.7 per cent of women in the age group 29-39 were diabetics, while there were 41.8 and 61.4 per cent of men and women respectively in the age group 60-79. The only women and 2 out of the 4 men in the age group 80+ were diabetics.

Table 16 shows the number of patients in each diagnostic category, as they stand after a period of follow-up (1-4 years).

Table 16/

Figure 3.

Frequency of hyperglycaemia and renal glycosuria in 455 G.T.T. patients.

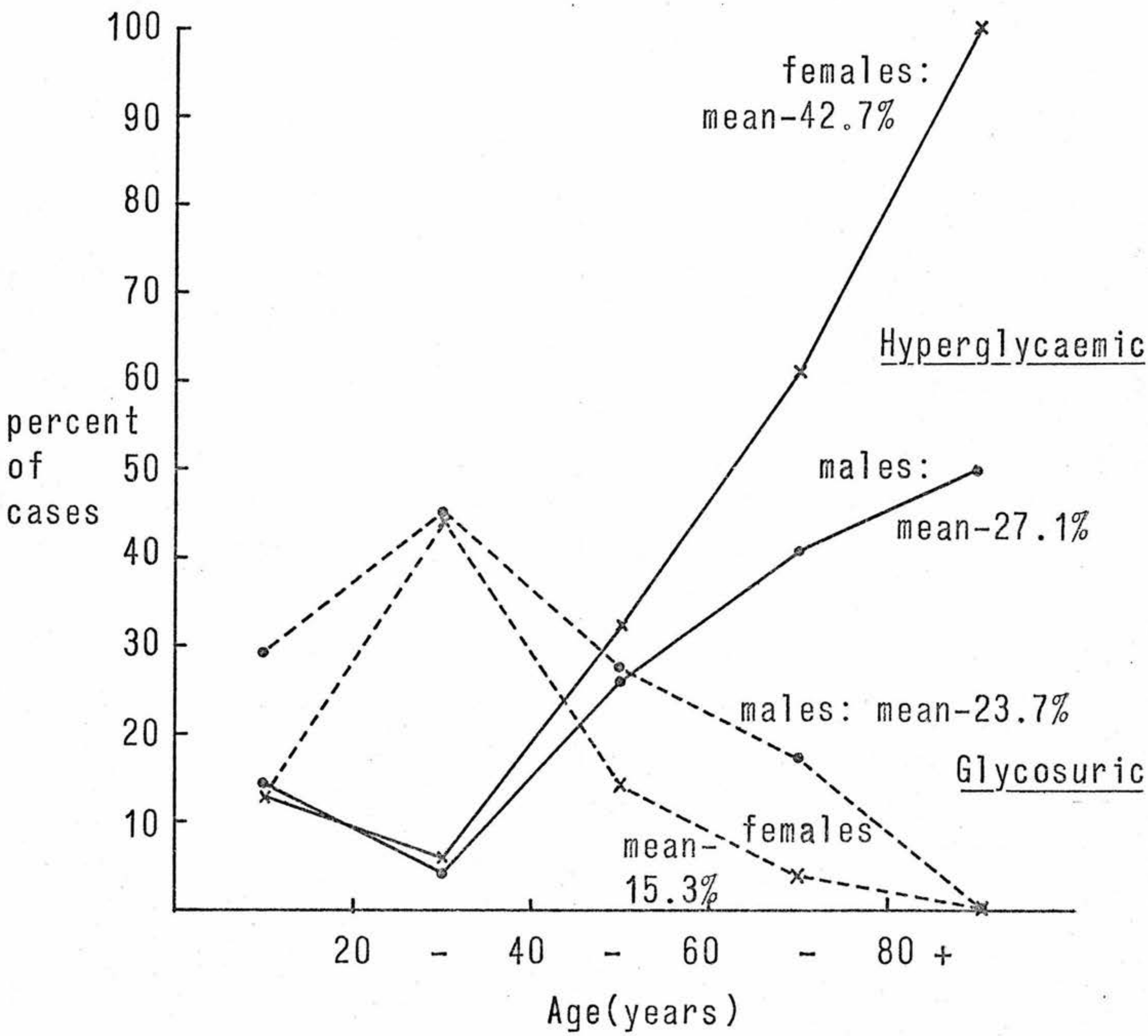

Table 16: Diagnostic classification of 455 G.T.T. patients

Age	Total	Normal curve	Renal glycos-uria	"Diabetic curve" and "Diabetic abnormalities" (Hyperglycaemia)	"Other Abnormal-ities"
< 20	36	20	8	5	3
20-39	141	56	63	7	15
40-59	163	60	38	45	20
60-79	110	29	14	55	12
80+	5	2	0	3	0
	455	167 (36.7%)	123 (27%)	115 (25.3%)	50 (11%)

The frequency of normal curve was 36.7 per cent, and this was commoner among young age group than old.

"Other abnormalities" was only 11 per cent of the total results, which is the lowest frequency among all diagnostic categories. The frequency is somewhat uniformly distributed among the various age groups.

Renal glycosuria was common among the young age group (highest at the age group 20-39), then its frequency declines with increasing age until the age of over 80 years where no patients with renal glycosuria were recorded.

The frequency of diabetic curve and diabetic abnormalities together (hyperglycaemia) was lowest at the age group 20-39, and increased with advanced ages.

Figure 3 shows the comparison between the frequency of hyperglycaemia, which includes "diabetic curve" and "diabetic abnormality" and that of renal glycosuria. The frequency of renal glycosuria was greater in men than in women, while hyperglycaemia was found more often in women than in men. It is also seen that renal glycosuria declines as the age progresses. However, it starts at the age group of less than 20 years, with lower frequency than that at the ages 20-39. This probably was due to the smaller number of patients tested in the younger age group.

The mean prevalence of renal glycosuria among the 455 patients was 23.72 per cent and 15.34 per cent for men and women respectively. The mean prevalence of "hyperglycaemia" for men and women was 27.1 per cent and 42.7 per cent respectively.

The Bedford survey reported mean prevalence of hyperglycaemia among glycosuric patients of 22.7 per cent and 42.2 per cent for men and women respectively. Hyperglycaemia was defined by 2 hour blood glucose value over 120 mgm per 100 ml in glycosuria persons. The frequency of glycosuria in that survey was also greater in men than in women. In those aged over 70 years, glycosuria was nearly always due to hyperglycaemia, and not to a low threshold. Glycosuria indicated hyperglycaemia in only about 5 per cent of young adults of either sex, but in over 70 percent of elderly women (Butterfield, 1964).

The frequency of post-prandial glycosuria was found to be 4 per cent of 2500 persons tested. Two-thirds of those, on glucose tolerance testing, had 2 hour blood sugar level below 120 mgm per 100 ml. It seems very probable therefore, that the blood sugar level at time of producing the urine specimen was well below the 180 mgm per 100 ml, which is commonly regarded as about the normal threshold. This would give anprevalence of renal glycosuria in the general population of $\frac{2}{3} \times 4 = 2.7$ per cent. This seems a low figure and a real figure may be considerably higher than this, since blood sugar values after meals are usually no higher than 120 mgm per 100 ml; if the blood sugar had been raised to 120-180 mgm per 100 ml (e.g. by glucose feeding), a greatprevalence of renal glycosuria would presumably have been found. The Bedford study demonstrated that some 30 per cent of 570 apparently normal persons showed glycosuria in the course of a 50 gm glucose tolerance test.

Some authorities in the field, like those of the Joslin Clinic in U.S.A., agree only to a low frequency of renal glycosuria, by restricting the diagnosis of renal glycosuria to a condition in which the renal threshold is extremely low. They define glycosuria as renal glycosuria only when all specimens of urine examined, including those after an overnight fast, contain glucose. In so doing they discard the numerous other cases whom they term "unclassified glycosuria",* but would be recognised as renal glycosuria by the majority of workers, who, following R.D.Lawrence (1947), define renal glycosuria as glycosuria discovered in the

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*Unclassified glycosuria, according to Joslin's clinic classification, includes: glycosuria accompanying hyperactivity of endocrine gland other than the pancreas; glycosuria due to stimulation of intra-cranial centres; alimentary glycosuria; glycosuria accompanying infections; toxaemia; anasthesia and asphyxia; glycosuria in chronic or degenerative diseases; and glycosuria due to chemical agents.

course of a normal blood sugar curve. In the Joslin Clinic, by limiting the diagnosis as outlined above, renal glycosuria is uncommon. They reported that among 50,000 cases of melituria there were only 85 cases (0.17 per cent of renal glycosuria (Marble, 1971b). All workers, including those of the Joslin Clinic, agree that renal glycosuria is a condition set apart from diabetes, and it is a benign condition, characterised by excretion of glucose in the urine in the presence of a normal amount of glucose in the blood, even during a tolerance test. The rate of utilisation of carbohydrate is normal, ketosis develops during starvation rather than following dietary excess, diabetic symptoms such as polyuria and thirst are absent, and without treatment renal glycosuria is not progressive. Some physicians believe that renal glycosuria may progress to true diabetes (Drucker, Fitch & Gaston, 1962; Martin, Salassa & Sprague, 1960). However, in a study of approximately 2000 patients included in the first 14,000 patients with glycosuria seen at the Joslin Clinic, not a single instance of progression to true diabetes was found among the 45 patients with renal glycosuria, despite the fact that most of these had exhibited glycosuria for 10 years or more (Marble, et al, 1939).

Robbers and Rumelin (1953), also believe that renal glycosuria does not progress to diabetes. They reported 60 patients with renal glycosuria observed over 2 to 36 years (in most of the subjects, over 8 years). None of them had developed diabetes.

When 42 cases of renal glycosuria discovered during the population survey in Birmingham were re-examined 5 years later, none had become diabetic. In our present study not one of the 123 who had renal glycosuria is known to have developed diabetes at the end of the observation period (1-4 years).

It seems probable that renal glycosuria and diabetes are aetiologically unrelated conditions, but because renal glycosuria is a common condition in normal people, it is natural to find instances where it has been known to exist, and diabetes has later appeared.

From the preceding discussion on the resultsof glucose tolerance test it is reasonable to suggest that similar results to those obtained from whole population surveys could be obtained from surveys of patients referred to a large diabetic clinic.

Diabetes Annual Incidence

In most patients, diabetes announces its presence in unmistakable terms, and the diagnosis is not difficult to make. In other patients, when there is doubt about the diagnosis, the glucose tolerance test would be helpful in reaching a diagnosis, although the validity of the diagnosis of diabetes in these doubtful cases has been questioned. In clinical practice the final diagnosis will also depend on the patient's history and other clinical findings. It is said that in clinical practice, unlike the situation in population surveys, there is a more defined line between the "normals" and the "diabetics", and the question of borderline cases rarely exist. In the case of diabetics at least, this is not quite true. There is a category of patients whom the physician in clinical practice does not consider to be diabetic and yet in whose case he suspects a heightened danger of diabetes developing. In these cases he recognised that it is not harmful to the patient's general health, but may do considerable good to advise him to lose weight and to follow a more sensible dietary regime. In our present study the decision, which was taken by the physician in the diabetic department regarding the diagnosis of diabetes, has in all instances been accepted. This point has been discussed earlier.

The time of the onset of diabetes is often indefinable in adults, while in children it can usually be determined precisely.

In juvenile diabetes there is often little or no pancreatic function and the onset is often acute, especially if coincident with an infection or some other stress, which makes the available insulin, if any even less effective. By contrast, the adult's diabetes may be insidious in onset, with evidence of gradually decreasing glucose tolerance over a period of months or years. The recognisable symptoms like polyurea, polydypsia, and polyphagia, often do not appear in the adult with diabetes until the condition has been present for many years. The appearance of these symptoms is no longer considered an indication of early stages of the disease, but they may be considered as evidence of pancreatic decompensation. The symptoms which lead the patient to seek medical advice on the other hand, are usually mild at the beginning and may be neglected by the patient for some time. Thus the date of onset in the majority of the patients cannot be determined accurately, and the date of diagnosis marks the onset of the illness.

In the present study, the age at diagnosis was considered as the age last birthday. In all patients studied the age at diagnosis was taken as the age of onset of the symptoms. Only 17 patients (7 males and 10 females) studied in the diabetic department had complained for more than one year before diagnosis of symptoms which were suggestive of diabetes. In 8 patients symptoms had been present for one year, and for more than one year in the other 9 patients (Table 4 in the Appendix). These complaints were not clear either in nature or in duration. They were stated by the patients on their first visit to the clinic

Table 17: Distribution of patients first seen in the Diabetic Clinic, 1969-71, according to duration of diabetes by sex

Year of 1st attendance	"DURATION"						
	"No duration"	1 yr	2yrs	3-4yrs	5-9yrs	10+yrs	Total with "duration
	M A L E S						
1969	95	0	2	2	5	4	13
1970	112	2	2	3	5	6	18
1971	92	0	1	4	5	10	20
Total	299	2	5	9	15	20	51
	F E M A L E S						
1969	95	2	5	3	4	7	21
1970	127	1	1	5	2	3	12
1971	151	1	0	4	5	9	19
Total	373	4	6	12	11	19	52

(all 17 patients were diagnosed during 1969-71 period). The symptoms were mild in nature and in most females (8 out of 10) were pruritis vulvae which might have been caused by other diseases.

In 5 males, the complaints were of thirst, and the other 2 complained of generalised malaise and tiredness for a period of more than two years. Because of the undefined nature and duration of the complaints, and because there was no medical supervision during the period since the beginning of the symptoms until the time of diagnosis. The date of diagnosis for these patients was also considered to mark the onset of the disease.

Of the 775 patients studied in the diabetic department, 672 (299 males and 373 females) were newly diagnosed, and the date of diagnosis (year) was the same as that of their first attendance. 103 patients (51 males and 52 females) came to the clinic one year or more after diagnosis. In the period between the establishment of the diagnosis and the first attendance at the clinic, they were under medical supervision. Table 17 shows the distribution of the patients according to the duration of their illness before the first attendance. (Table 5 in the Appendix shows the age distribution of these patients.) The reason for their referral after an elapse of one or more years varied. In the younger age group it was mainly due to the fact that their diabetic control was supervised by the Royal Hospital for Sick Children. The main cause in the case of older patients was that their disease was mild and supervised by either their general practitioner or by other hospital departments.

Table 18: Distribution of newly diagnosed patients according to year of diagnosis per age and sex, Diabetic Department, Royal Infirmary and other hospitals - 1969-71

Year of Diagnosis	All ages			< 10		10 - 19		20 - 29		30 - 39		40 - 49		50 - 59		60 - 69		70 - 79		80+	
	M	F	B	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1969																					
Diab. Dept. R.I.E.	99	96	195	0	0	5	2	8	2	4	4	8	9	15*	14	35	42	18	20	6	[illegible]
Other hosps	37	46	83	3	2	2	-	-	1	1	1	3	5	5	11	16	13	6	13	1	[illegible]
Total	136	142	278	3	2	7	2	8	3	5	5	11	14	20	25	51	55	24	33	7	[illegible]
1970																					
Diab. Dept. R.I.E.	112	128	240	0	0	7	5	3	4	6	5	10	15	22	23	43	37	18	29	3	[illegible]
Other hosps	43	40	83	3	3	4	2	1	1	1	1	6	1	4	7	16	11	5	12	3	[illegible]
Total	155	168	323	3	3	11	7	4	5	7	6	16	16	26	30	59	48	23	41	6	[illegible]
1971																					
Diab. Dept. R.I.E.	92	151	243	1	0	8	8	1	4	5	3	16	11	26	28	26	51	8	40	1	[illegible]
Other hosps	54	57	111	2	2	2	5	3	2	1	3	3	3	15	4	15	20	9	12	4	[illegible]
Total	146	208	354	3	2	10	13	4	6	6	6	19	14	41	32	41	71	17	52	5	[illegible]
Total of 3 years	437	518	955	9	7	28	22	16	14	18	17	46	44	87	87	151	174	64	126	18	[illegible]

* 1 patient included here was not included in the study due to "no data" available. His G.T.T. results indicated he was diabetic.

M = Male
F = Female
B = Both sexes

The number of patients who first attended in the year 1969 was 224, of whom 34 patients (13 males and 21 females) had the disease for one or more years before attendance. 190 (95 males and 95 females) patients were diagnosed at their first attendance and had, therefore, "no duration".

Out of 269 patients who attended in 1970, 239 (112 males and 127 females) were with "no duration", and 30 (18 males and 12 females) had a duration of one or more years between the diagnosis of the first attendance. 2 males and 1 female were diagnosed in 1969 but attended the clinic in 1970 (duration of one year).

There were 282 patients who attended the clinic for the first time in 1971. 243 (92 males and 151 females) attended in the same year as that of their diagnosis. 39 (20 males and 19 females) had the disease for one or more years before their attendance. One male who attended in 1971 was diagnosed in 1969 (duration 2 years). One female attended in 1971 and diagnosed in 1970 (duration 1 year).

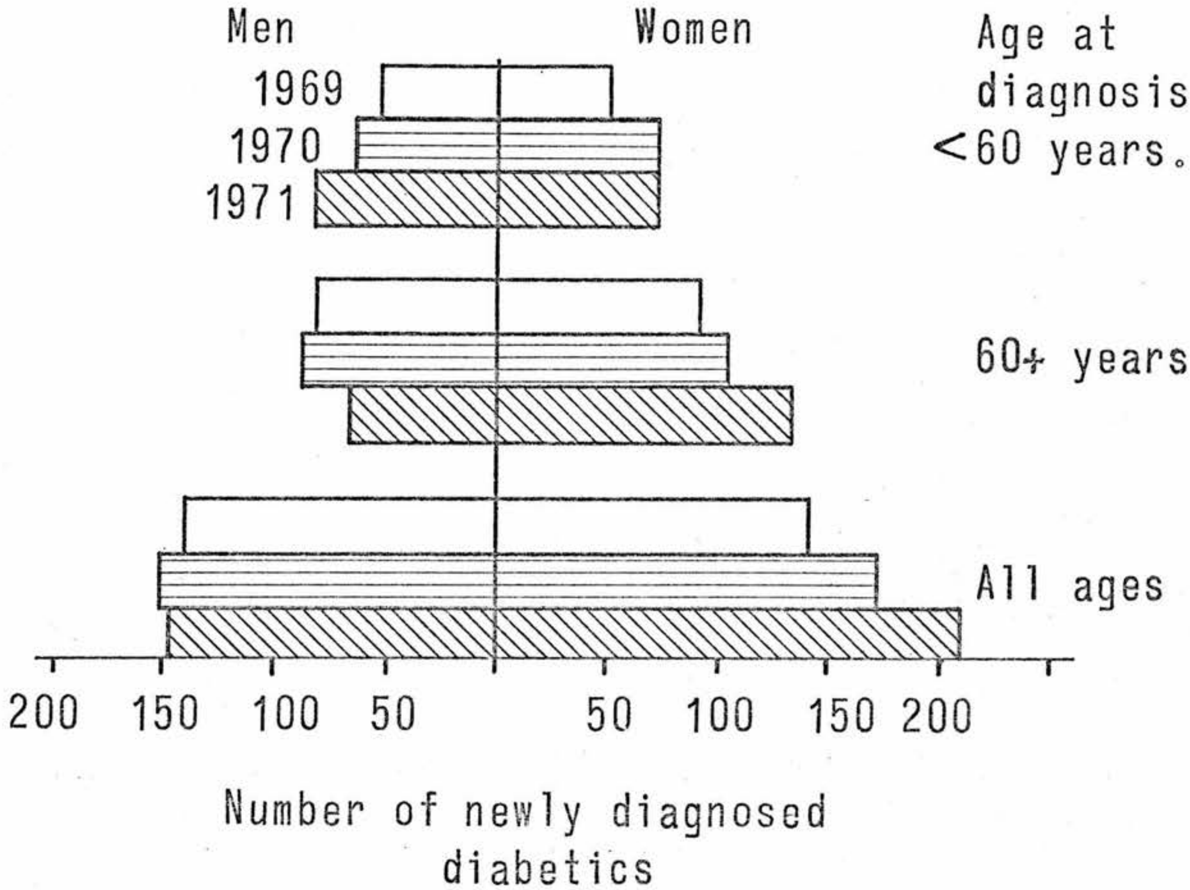
Patients who were diagnosed in 1969 and 1970, but attended the department one or two years later were included under their appropriate year of diagnosis. Table 18 shows the number of newly diagnosed patients in Edinburgh in the years of 1969, 1970, 1971.

The total number of newly diagnosed patients attending other hospitals who were not referred to the diabetic department was 277 (143 females and 134 males).

The age-sex distribution of these patients, according to the hospital they were attending is shown in Table 6 in the Appendix.

Figure 4.

Diabetes : annual incidence. Edinburgh, 1969, 1970 & 1971



Age at diagnosis	1969	1970	1971	Chi-square d.f. = 2	Probability
		MALES			
< 60	54	67	83	6.20	<0.05
60+	82	88	63	4.39	Not significant
All ages	136	155	146	1.24	Not significant
		FEMALES			
< 60	51	67	73	4.06	Not significant
60+	91	101	135	9.76	<0.01
All ages	142	168	208	12.81	<0.005
		BOTH SEXES			
< 60	105	134	156	9.93	<0.01
60+	173	189	198	1.72	Not significant
All ages	278	323	354	9.17	<0.025

The significance of change over the three year period.
Chi-square calculated on basis of one poisson distribution.

There was an increase in the total number of newly diagnosed diabetics from the year 1969 to 1971. This increase was experienced both by the Royal Infirmary and other hospitals.

There was an increase in the number of females, expecially in the older age group, from 1969 to 1971. There was a less obvious increase in the case of males, and the number was less in 1971 than in 1970 (146 compared with 155). This decrease was due to less males in the older age group being diagnosed in 1971 and this might be due to incomplete coverage of those diagnosed in that age group, while males in the younger age group show continuous increase over the period of the three years.

Figure 4 shows the pattern of increase in newly diagnosed diabetics over three years, and the table shows the statistical significance of these changes for both sexes divided into two major age groups. Under the age of 60 years the newly diagnosed diabetic shows an increase for both sexes over the three year period. This increase is statistically significant (but not practically significant). The increase was mainly in the newly diagnosed males under the age of 60 years. Females in the same age group show no significant increase over the three years.

No significant difference was noted for theincrease in the number of diabetics over the age of 60 years, in both sexes taken together. However, taking females only above 60 years, the increase over the three years is statistically significant.

The period of three years is too short to predict whether this increase is real, in a sense which will be discussed, beside the fact that the number of patients involved is not large enough to avoid sampling error. The number of patients studied over this short period does not allow positive interpretation of the increase in the annual incidence. However, it is reasonable to believe that this increase is an apparent and not a real one. It is partly due to more newly diagnosed patients being referred from general practitioners to hospitals at the time of diagnosis. More patients have been referred to hospitals in recent years than was the practice in the past. This was suggested by two general practitioners who were interviewed, and it is also suggested by the number of patients referred to the clinic with duration of one or more years after diagnosis (Table 17). The majority of the 103 patients who had a "duration", were diagnosed before 1968, while within the period of the study, 1969-71, only 5 patients were referred with one year (4 patients), or two years (1 patient) after diagnosis. It seems that the general practitioners in recent years are retaining less diabetic patients within their practices, and more patients with newly diagnosed diabetes are being referred to hospitals.

The increase in the cases presenting themselves annually could also be due either to an increase of the true incidence of the disease or to an increase in the proportion of diabetics whose condition has been diagnosed. The increase over three years observed in the present study, could not practically be explained on an increase of the true incidence. However, the increase could partly be due to more awareness concerning diabetes, and this could result in more patients with diabetes being diagnosed, who otherwise would remain undiagnosed. It is well known from population surveys that about as many new, previously undetected, cases are found as there are known diagnosed cases. If the true prevalence remains constant, i.e. the total of undetected and known cases, then an increase of the detection rate would lead to a reduction of the number of new cases found in a population survey done in the future. Malins (1968b), listed the results of eight such population surveys with publication dates between 1947 and 1964; the later surveys, however, do not tend to have a lower proportion of new cases. If the detection rate differs between localities and times, but the true prevalence is the same, there would be a negative correlation between the frequency of known cases and the frequency of new cases in such surveys. Conversely, if the detection rates are the same but the true prevalence differs, there would be a positive correlation. The correlation in the surveys listed by Malins is -0.36, but it is not significantly different from zero. Though inconclusive, this line of evidence is suggestive of a constant true prevalence and a variable detection rate. The present study, because it deals only with known diagnosed cases, cannot throw any light on this problem, which will only be solved by further surveys in which the unknown cases are detected. Falconer, et al (1971), observed 3 per cent annual increase of new cases by studying the number of registrations at the diabetic department over the period from 1948 to 1968. They suggested that with the proportion of undetected cases being about one half, an increase of 3 per cent in the observed annual morbidity risk would result from a 3 per cent reduction in the proportion of undetected cases. If the proportion of undetected cases decreased continuously by 3 per cent per annum, the proportion of undetected cases would be halved after 23 years, or it would be reduced from 50 to 37 per cent after 10 years.

Thus they suggested that a period of 10-20 years between surveys might well be sufficient to detect the change.

In the United States of America the data from National Health Interview Surveys based upon household interviews, showed a steady increase both in numbers and rates of prevalence of diabetes mellitus (Marks, Krall & White, 1971). The overall numerical increase between 1957-1959 and 1965-1966 surveys was 1,242,000, or 81 per cent.

At all ages combined, both the numerical and relative increases have been somewhat larger among females than males. The increase has been fairly general by age and sex. Comparing the results of the years 1957-59 with that of 1965-66 for all ages, the rate per 1000 increased from 8.0 to 12.9 for males, and from 10.0 to 16.1 for females.

In some age and sex categories the rates have not increased uniformly. This was explained as probably being due to variation in sampling. The increase in the number was explained as being due in great part to the steady rise in the population of the country as well as increased longevity of diabetics, but other factors have influenced the trend. These were summarised by Dr.Philip E. Lawrence (1965), who was in charge of the programme; in commenting on the increases in the estimates of diabetes prevalence between 1959-1961 and 1961-1963, he stated: "The increases that appear in these two sets of data may be due to (a) increased efforts at detection of diabetes, (b) increased awareness of the population about diabetes and other conditions as well, and (c) gradual improvements that we have been instituting in our questionnaires in an effort to improve the reporting of chronic diseases".

On the basis of the data from the survey, collected in the fiscal year July 1965 to June 1966, the number of known diabetics in the United States was estimated to be about 2,800,000; and if the age-specific rates recorded for that period are applied to the estimated population of the country as at July 1, 1970, the estimated number of known diabetics at that time would be approximately 3,000,000.

The National Health Survey of 1935-1936 (U.S.Public Health Service) reported a prevalence as at 1937, based upon the sex-age specific rates observed in the survey. It was estimated at approximately 500,000, but the figures were adjusted upwards to 660,000 to allow for under-enumeration.

Comparing the 1961-63 survey with the earlier survey of 1935-36, at all ages combined, the rate has risen threefold; for males, the rate increase has been much sharper than for females, with the reported rate for 1961-63 for males being three and two-thirds times the earlier rate as compared with two and two-thirds times the earlier rate for females.

Changes in sex ratio

Sex seems to play an increasingly important part in the incidence of diabetes mellitus, and although at the present time diabetes is commoner in women than in men, in the last few years there seems to have been a change towards a greater relative incidence of diabetes among men. Males exceeded females a century ago, but this situation had reversed, starting at the second decade of the present century when both the incidence and mortality from diabetes appeared to be higher among females (Bouchardat, 1875; Sandbury, 1891; Paveym 1885; Joslin & Krall 1959).

Although mortality data are not a very reliable source of information about the incidence of diabetes, especially since the introduction of insulin therapy, it is worth while examining the trend in sex ratio variation in diabetes mortality statistics. Before doing so it should be noted that the diabetic deaths recorded on the death certificates do not represent the total number of persons who die with diabetes, for two reasons. The first is the priority accorded by established rules of classification. A second factor in the non-recognition of diabetic deaths is the omission in more than a third of the patients of any refetence to diabetes by the doctor when reporting the death (Cameron, 1966).

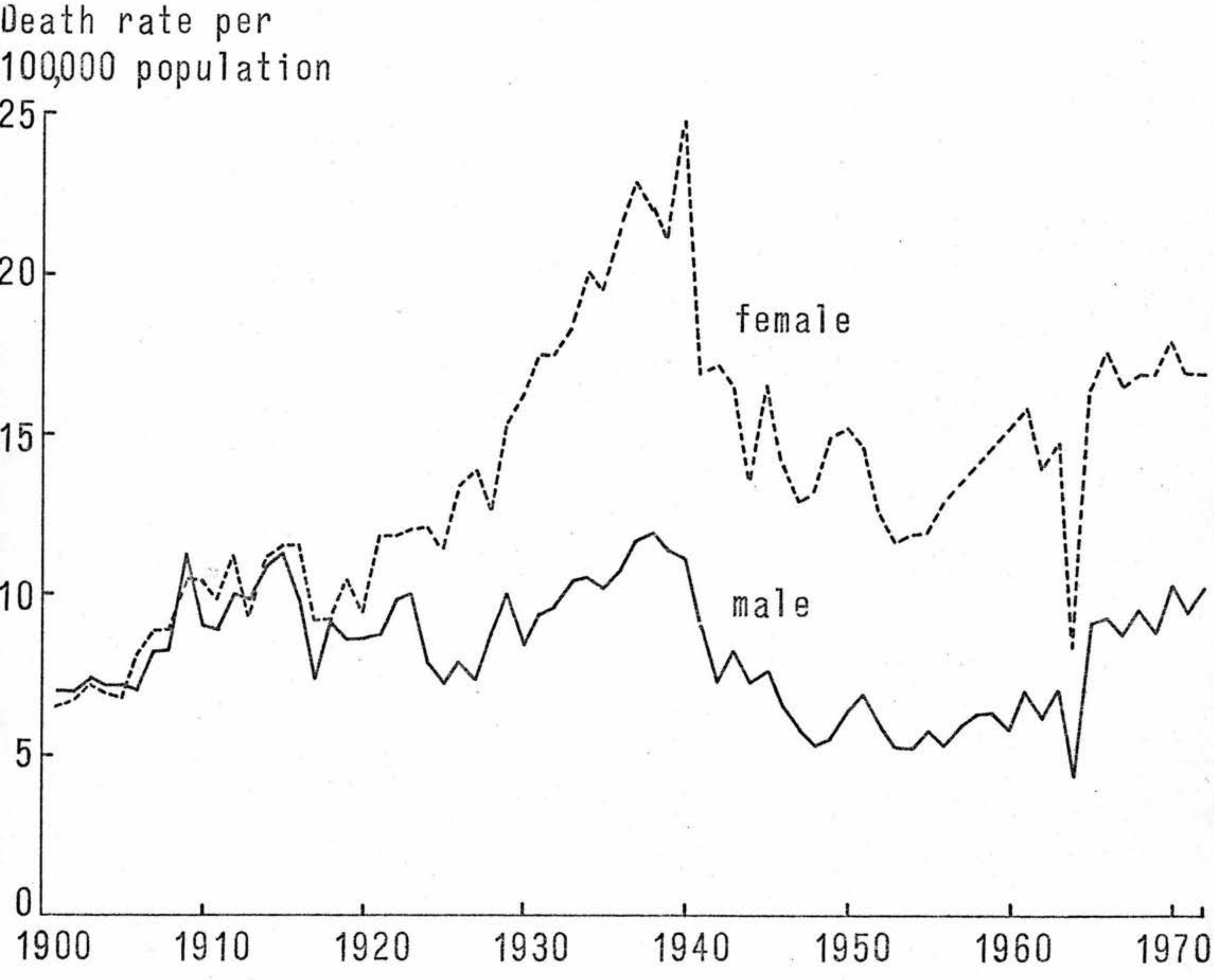
In the U.S.A. when the transition to the sixth revision of the International Classification of Deaths took place in 1949, the total number of deaths and death rates had practically been reduced to nearly one-half in the following year. The death rate for both sexes per 100,000 in the year 1950 according to the sixth revision, was 16.6, and for the same year but according to the fifth revision, it was 29.7 (Joslin & Krall).

H. Harris and N. MacArthur (1951) had shown from the mortality statistics from Britain, Scandinavia and North America, that 60-70 years ago deaths from diabetes in men and women were equally numerous, and that the female predonderance has gradually emerged since 1910, the death rate for men having stayed constant, that for women having risen steadily since 1920. A century ago there was a ratio of men to women of 2 to 1 in the recorded cases of death from diabetes. The progressive change that has taken place in the sex ratio in mortality from diabetes had also been noted by Stocks (1944), and would be experienced in many countries of the world. Using the population of England and Wales in 1901 as the basis of standardisation, Stocks reported that the ratio of male to demale deaths from diabetes had fallen from 2.05 in 1861-1870 period, to 0.83 in 1940-1941 period. Similar changes have been observed in most other countries in Eutope, America and Australia (Lancuster & Maddox, 1950).

It is a common experience that when a disease becomes treatable more cases are discovered. Probably after the discovery of Insulin in 1922, cases of diabetes were diagnosed that would not previously have been, particularly relatively mild cases such as often occur in middle age, more frequently in women than in men. The various hormonal changes that occur in females during pregnancy and menopause, and the lessened degree of physical activity, especially after the onset of menopause, with the resultant increase of obesity, are factors favouring the increased incidence among females. It seems that these factors have been augmented at the turn of the century

Figure 5.

Diabetes: death trends in Scotland. 1900 - 1972.



Sources:

W.H.O. Epidemiological and Vital Statistics Reports, Vol. 8, 1955; Vol. 17, 1964; Vol. 24, 1971.

Figures for the years 1962-72 from Annual Reports of the Registrar General for Scotland Nos 108 - 118.

by improved economic status of families, from large scale industrialisation, and a closer medical supervision that is maintained over females of middle and old age groups. It is most likely that some or all of the above factors were responsible for the changes that have occurred.

The sex difference in mortality rate from diabetes mellitus in Scotland, since the start of the century, which is more or less similar to that experienced in England and Wales and other European countries, is shown in Figure 5. (Crude death rates)

The changeover from a slightly higher male ratio to that of a higher female ratio took place in the first decade, but the real increase in female death rate started in the year 1918, the year of the termination of hostilities in the First World War. From then onwards the excess of female over male rates continued to increase gradually, until the peak level was reached in 1940, the year following that in which the Second World War commenced. A similar picture was noted in England and Wales (the change took place in 1920 and the peak was reached in 1939) and other European countries that were involved either directly or indirectly in the hostilities that ensued at the time, notably in Norway and Sweden where the changeover in sex mortality took place in the years 1919 and 1920 respectively.

It is obvious that some unknown factor or a group of factors have been responsible for effecting these changes. It is just possible that the wars produced this dramatic effect by altering the basic structure of the populations of the countries involved, due to a reduction in the male population in the age group 20 to 45 years. The effect of this sudden alteration in the population's structure proved to be a continuous one as shown by the gradual increase in the excess of female rates over the male rates during the succeeding years, probably due to the reduction in the number in the male population groups reaching the susceptible age groups where the prevalence of diabetes mellitus is highest. Another possibility is that in addition to the above factors, certain important changes took place in the social and economic structure of most countries during the period, which tended to intensify these changes. One such effect is probably the growing respect in which women are held at the present time throughout the world. This to all intents and purposes, had its origin only at the turn of the century, as is evident from the statistical data available on the subject. They are subject to greater medical supervision, and it is a well-known fact that females generally live longer than males, so that there is a greater possibility of larger numbers of females surviving to that age zone when diabetes is most likely to have its onset.

The drop in rates during and following the Second World War was equally experienced by males and females, and probably was due to the hostilities of the war and food rationing established at that time. The decline in mortality lasted till the early fifties; after that the mortality for both sexes started to increase and continued to do so till the present time. However, the ratio of male to female death showed a different picture. After the war, female mortality continued to increase more in proportion to that of males, till the early sixties when the increase in male mortality was proportionately more than that of females. In Scotland, the

the ratio of male to female in the year 1940 was 0.42, in 1950 it was 0.40, which became 0.36 in 1960, then it started to increase and reached 0.55 in 1972. The trend in other European countries was more or less the same. In England and Wales the ratio in 1939 was 0.79 and became 0.50 in 1960. In 1970 it was 0.58.

It seems that in the last decade the mortality from diabetes increased in males to a greater extent than in females.*

In the U.S.A. the death rate for women began to decline in 1950. Between 1950 and 1953, the death rate due to diabetes among white males varied little and again at a slightly lower level, from 1954 to 1959. Since 1960, the rate has risen to a level appreciably above that in the early 1950's. Among white females the rate showed a clearly downward trend over the entire period from 1950 to 1967, but the rate remained quite stable from 1964 to 1967. Among non-white males the death rate varied moderately in the period 1950 to 1956, but since 1956 has increased greatly and fairly steadily. The rate in 1967 was over 50 per cent higher than in the early 1950's. Among non-white females likewise the overall trend has been unfavourable in recent years, but the rate has risen, to a lesser extent, by about 30 per cent than it

* In Scotland, there was a sudden decrease in mortality for both sexes in the year 1964. With effect from 1st January 1964, the form of Scottish medical certificate with cause of death was revised to conform with the international form of medical certificate of cause of death recommended by the World Health Organisation (Annual Report of the Registrar General for Scotland, 1964, No.110, p.21). The reduction in the number of deaths from diabetes in 1964 (337) which is 236 fewer than in 1963, could be due to the change over, which happened that year. For example, in some cases of the old certificate diabetes mellitus will have been mentioned first as the primary cause, and coronary thrombosis placed among the secondary causes. While in 1964, on the new certificate, coronary thrombosis is being given as the underlying cause in the sequence of causes leading to death, and diabetes relegated to other significant conditions. However, in the following year, 1965, rates for both sexes increased to a level even higher than that in 1963, and the probable explanation for this is that, a year after adopting the new form, the certifying doctor went back to classifying the entries in the new form according to the old system

was in the early fifties.

The causes of the upward course of mortality, especially in recent years, are not entirely clear. The general trend has been an upward one almost everywhere and very sharp increases have been recorded in many countries, notably Austria, Denmark, Japan, Belgium, Finland, France, Italy, Northern Ireland and Scotland. In some of these countries it may have been partly due to changing coding procedures to conform with the W.H.O. Classification Convention. In part also, the great improvement in the economy of many countries, particularly in Western Europe, and the great affluence of its people, may have brought an increase in the prevalence of obesity and consequent development of diabetes. Increased effort at case finding may also be a prime factor in some countries.

These trends are partly due to the changes in the age-sex composition of populations; for diabetes, the important factor is the growing proportion of elderly persons, particularly females. Marks, H.H. (1971), accordingly computed an age-adjusted rate for each sex in nine selected countries for the years 1951 to 1952, and 1958 to 1960. The adjustment was made for age on the basis of a standard million population, United States, 1940. Here again the mortality trend has been shown to be more favourable among females than among males, with decreases for females at all ages combined, in six of the nine countries. Death rates at ages under 25 years have dropped sharply over the period examined, and in many places the decline is 50 per cent or more. At ages 25 to 44 years also, there have been substantial

Table 19: Sex distribution in results of various studies with male to female (M/F) ratio

STUDY	YEAR	MALES Number	percent	FEMALES Number	percent	M/F ratio
ctoria Infirmary, Glasgow (a)	1949	402	30.7	907	69.3	0.44
abetic Clinics: Gen. Hosp. d Children's Hospital, rmingham (b)	1949	131	31.4	286	68.6	0.46
abetic Department, Royal firmary, Edinburgh (c)	1949-50	197	34.0	382	66.0	0.52
neral Practitioner Survey st Cornwall (d)	1952-54	234	39.5	359	60.5	0.65
abetic Clinics: Gen.Hosp. d Children's Hospital, rmingham (b)	1958	273	44.4	342	55.6	0.83
ng's College Hospital, ndon (e)	1961-63	390	47.1	438	52.9	0.91
ESENT STUDY	1969-71	437	45.8	518	54.2	0.84

(a) Munro, H.N., Eaton, J.C., and Glen, A. (1949). Survey of Scottish Diabetic clinic: study of Etiology of Diabetic Mellitus, J. clinical Endocrinology, 9, 48-76

(b) Fitzgerald, M.F., Malins, J.M., O'Sullivan, D.J., and Wall, M. (1961): The Effect of Sex and Parity on the Incidence of Diabetes Mellitus, Quart.J.Med. N.S. 30, 57

(c) Werrasingha, H.D. (1962): Causes of Death and Survival among diabetics. Ph.D. thesis, Edinburgh University

(d) Cited In: C.T. Andrews (1957): A Survey of Diabetes in West Cornwall Brit. med. J. 1, 427

(e) Pyke, D.A. (1968): Aetiological Factors, in The Clinical Diabetes and its Biochemical basis, (editors), Oakley, W.C., Pyke, D.A. and Taylor, K.W., p.240, Oxford: Blackwell.

reductions in mortality rates among females in all of the nine countries but only in three among males. At ages 45 to 74, moderate declines among females have been recorded in the majority of countries, but among males the reverse is true. At ages 75 and over, however, rates have increased sharply in both sexes in most countries.

Turning now to the sex incidence of diabetes estimated from hospital statistics published over the past twenty years, there is evidence that the number of men with newly diagnosed diabetes is increasing at a greater rate than that of women. Table 19 gives the sex distribution of patients from the present study compared with those of some of the studies done during the past twenty years.

More than twenty years ago the ratio of male to female diabetics was 0.44. This ratio has more than doubled in recent years. It seems that in hospital practice nowadays one expects to deal with equal numbers of males and females, while in the past the diabetic clinic population consisted of two-thirds females and one-third males. The ratio of male to female patients in our present study (0.84) is approximately the same (0.83) of that calculated from the data on the prevalence of diabetes in Edinburgh on 1st January, 1968 (Falconer, et al, 1971). This ratio was for patients with zero duration, i.e. newly diagnosed in 1967. The percentage of newly diagnosed male patients was 45.3, while that of females was 54.7 per cent. It has been shown from registrations at the diabetic clinic for the years 1948-1968, that there was an increase of 3 per cent per annum in male registrations, but no increase in female registrations.

Analysis of attendance of new cases from 1930 to 1963 to the diabetic clinic of the Birmingham General Hospital (Malins, Fitzgerald & Wall, 1965), showed that the male/female ratio began to rise in about 1955 and has continued to do so, because the growth of the female population has eased, while that of males has progressed steadily.

The male over female ratio to those patients who first attended in 1930-34 was 0.56, while for those who attended in 1960-63 it was 0.89. The steepest rise in the ratio occurred in the latter ten years. It was shown that the trend suggested by the crude figures is equally present after they had been standardised against the sex distribution of the general population of the West Midlands, England in the 30- year period examined. The standardised male/female ratio is also calculated for each five year period from 1930 with the patients being divided into four age groups (Table 20).

Table 20: Ratio of the relative incidence of men and women M/F, for each age group at diagnosis. Birmingham General Hospital, 1930-63*

Year	Age group at diagnosis			
	20-34	35-49	50-64	65-79
1930-34	1.07	0.59	0.51	0.50
1935-39	1.60	0.69	0.31	0.54
1940-44	1.57	0.72	0.46	0.69
1945-49	1.54	0.65	0.44	0.38
1950-54	1.80	0.96	0.59	0.59
1955-59	1.75	1.47	0.86	0.74
1960-63	1.13	1.78	0.96	0.78

*Source: Diabetologia, 1, 121, 1965

The figures have been standardised for the population at risk in each age-group in the different years, either by using the census figures for the West Midlands in 1931, 1951 and 1961, or the Registrar-General's Estimates for the intervening years.

It appears that after 1950 there is an obvious and striking increase in the male/female ratio in the age group 35-49, and a highly significant increase at the greater ages. Among the young(20-34) a slight preponderance of men which was present 30 years earlier, had persisted in the later years, but in older patients a heavy preponderance of women in earlier years had given way to near-equality at ages over 50 years, and to a male preponderance in ages 35-49. These changes seem to suggest a genuine alteration in the sex incidence of diabetes, mainly at the middle and old ages. In the present study there is a preponderance of females in the ages over 60 years. Under the age of 60, the male/female ratio is 1.07; over this age, 0.71. Thus the sex ratic decreases by 1.07/0.71 = 1.51 fold after the age of 60. Correcting the ratio according to the sex distribution of the general population, the higher male/female ratio was shown to remain, even in the older age group (Table 21). The figure of corrected ratio over the age of 60 remained high in favour of males, inspite of the crude ratio of 0.71 for patients of all groups above 60 years. This means that although within the diabetic population females outnumber males, in the older age group male d abetics are relatively more in number than female diabetics in relation to the corresponding sex of the general population.

Table 21: Number of cases, crude ratio, and relative incidence diabetes/population x 10^3 for each 10-year age group, male and female, 1969-71, Edinburgh

Age at diagnosis (years)	Number of Cases Male	Number of Cases Female	Crude ratio of Male/female	Incidence x 10^{3*} Male	Incidence x 10^{3*} Female	Ratio of Male/female
0 - 9	9	7	1.29	0.23	0.19	1.21
10 - 19	28	22	1.27	0.82	0.68	1.21
20 - 29	16	14	1.14	0.51	0.43	1.19
30 - 39	18	17	1.06	0.67	0.63	1.06
40 - 49	46	44	1.05	1.72	1.53	1.12
50 - 59	87	87	1.00	3.43	2.86	1.20
60 - 69	151	174	0.87	6.68	5.69	1.17
70 - 79	64	126	0.51	6.34	6.22	1.02
80+	18	27	0.67	6.43	3.46	1.86

* using mid-year estimated population, Edinburgh, 1970.

Fitzgerald, et al, in 1961, showed that there is a male preponderance up to the age of 40 years, and a female preponderance after the age of 50 years. They had corrected the sex ratio of newly diagnosed diabetics from Birmingham General Hospital with that of the general population.

Comparing these findings with those of the present study, it seems that men may start to predominate over women even at the age of 50 years. This increase in number of males developing diabetes could be due to either more frequent diagnosis or to a real increase in the number of males developing diabetes. The use of routine medical examination for insurance or employment purposes has extended considerably in recent years, and applies to men more than to women. Moreover, the Working Party of the College of General Practitioners (1963) showed that routine testing of a normal population will disclose abnormal carbohydrate tolerance much more frequently in men than in women over the age of 50 years. An increase in routine testing, therefore, would produce an increase in the proportion of cases of mild or subclinical diabetes in males.

On the other hand, a real increase in the number of men might be attributed to their physical idleness with increasing mechanization of industry and the use of motor cars.

If the change in the male/female ratio is due to a decline in the number of females presenting with diabetes, this could hardly be due to the condition being less often diagnosed in them than formerly.

There is no hard evidence at present to indicate that the changing sex ratio could be due to a true fall in female incidence. There has probably been a slight decrease in body weight of women of middle age in the past 30 years, but this is unlikely to explain a reduction in the incidence of diabetes in women which would alter the sex ratio. Parity has been shown to be a factor in the incidence of diabetes in women (Pyke, 1956; Fitzgerald, et al, 1961). The decline in the average number of children in a family might well be followed by a fall in the incidence of diabetes in women. But the evidence does not support this idea. The really significant changes in family size occurred between 1880-86 and 1910-19, when the number of live births per woman fell from 5.3 to 2.3 (Glass & Grebenick, 1954). It can be calculated that the impact of this decrease would have affected incidence between 1910 and 1949, a period during which there is much to suggest that the number of women developing diabetes increased, instead of falling as would be expected if parity were the sole factor.

It is not possible to say with certainty whether there has been a relative increase in the male rate or a relative decrease in the female rate, but it is hard to believe that the shift in the sex incidence in recent years is not significant. The failure to identify any environmental factor which could have affected one sex more than the other leads to the same negative conclusion as Harris and MacArthur, (1951), when they drew attention to the relative increase in the female incidence which seemed to be taking place at that time.

Age of onset

Diabetes is mainly a disease of later life. It occurs at all ages but is rare in childhood and uncommon in young adults, but thereafter becomes increasingly frequent. Although it is known that the delay between the onset of diabetes and its diagnosis may be noticeable, especially in patients of the middle ages, the age at diagnosis would be used as the age of onset. Age at diagnosis is relatively easy to determine and gives a fair idea of the incidence of diabetes. Table 22 shows the number and percentage of newly diagnosed patients in each 10-year age group.

Table 22: Age at onset and sex incidence of 955 diabetic patients, 1969-71, Edinburgh

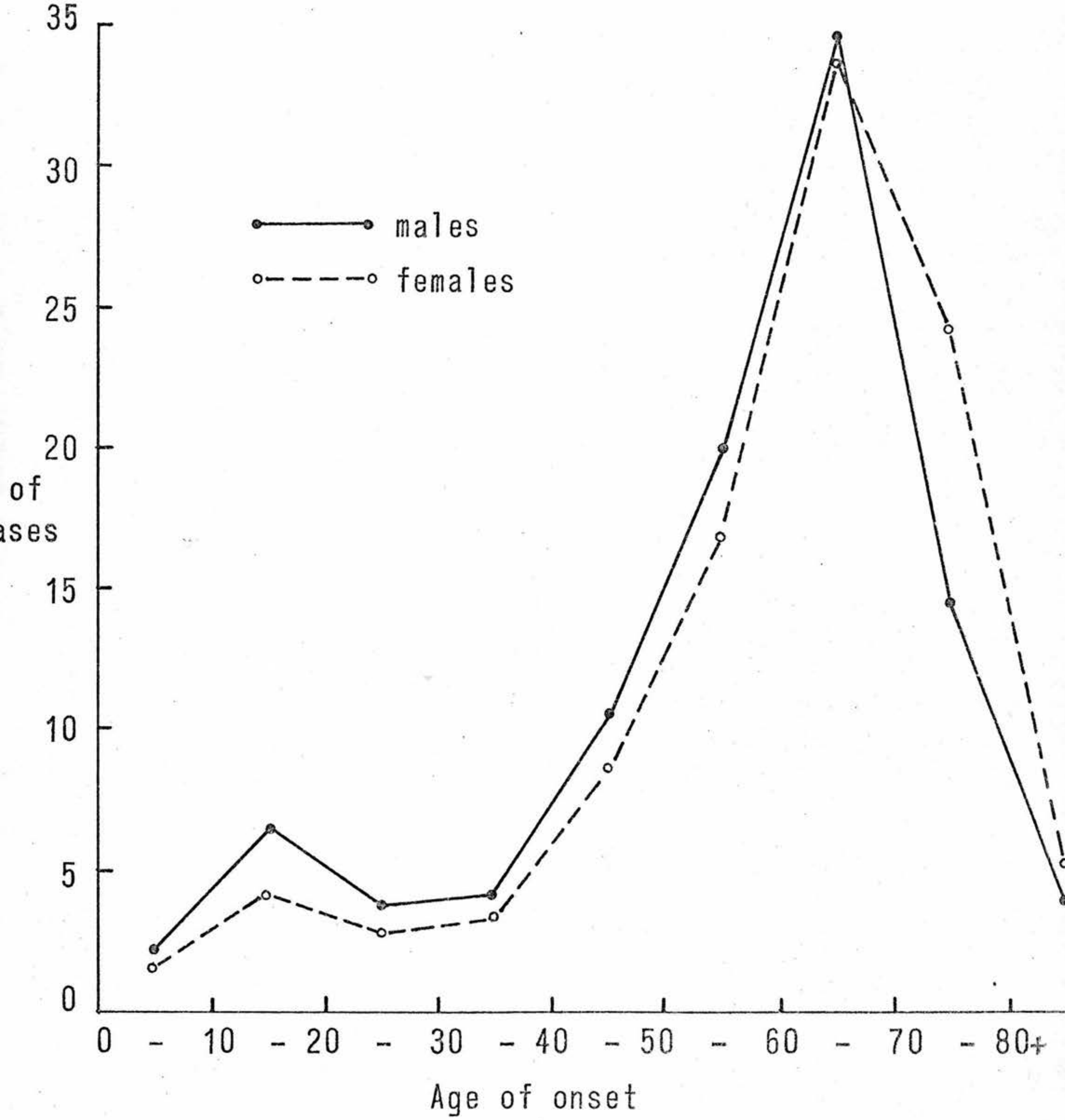
Age at diagnosis (years)	Males		Females		Males & Females	
	Number	%	Number	%	Number	%
0 - 9	9	2.1	7	1.4	16	1.7
10 - 19	28	6.4	22	4.2	50	5.2
20 - 29	16	3.7	14	2.7	30	3.1
30 - 39	18	4.1	17	3.3	35	3.7
40 - 49	46	10.5	44	8.5	90	9.4
50 - 59	87	19.9	87	16.8	174	18.2
60 - 69	151	34.6	174	33.6	325	34.0
70 - 79	64	14.6	126	24.3	190	19.9
80+	18	4.1	27	5.2	45	4.7
All ages	437		518		955	

There is a preponderance of diabetes in late middle age, and older patients. Only 23 per cent of diabetics are aged below 50 years. The preponderance of older patients is greater than it seems. The number at risk from diabetes in the general population declines with age. Of the general population in Edinburgh at 30th June 1970, only 32 per cent are aged over 50 years, but 77 per cent of diabetics are over this age. Thus the apparent frequency of clinical diabetes increases about tenfold between childhood and late middle-age, the real incidence being about twentyfold.

The number of diabetics increases steadily with age, apart from a slight decrease in the age group 20-39, which is preceded

Figure 6.

Diabetes: distribution of age of onset.
Edinburgh 1969-71.



by a small hump (Figure 6).

The number of males and females reaches a peak in the age group 60-69. After that age females start to outnumber males; but both sexes show a rapid decrease in their number with advanced ages.

The most frequent (modal) age at onset is the same for both sexes, i.e. between the ages 60-69. However, earlier onset is more frequent among males than among females and later onset more frequent among females than among males. The mean age of onset is thus lower in males (56.1 years) than in females (60.1 years) (Table 23).

Table 23: Mean and Median ages of onset, 955 patients, 1969-1971

Year of Diagnosis	MEAN			MEDIAN		
	Male	Female	Both Sexes	Male	Female	Both Sexes
1969	57.4	60.6	59.0	62.8	63.7	63.3
1970	56.1	59.8	58.2	61.9	64.6	62.6
1971	54.5	60.1	57.7	57.6	64.4	61.9
All groups 1969-71	56.1	60.1	58.3	61.0	63.9	62.6

The mean age of onset is lower in males than in females, in the three years studied. The median age at onset follows the same pattern as that of the mean, but it is higher than the mean in both sexes. Thus the distribution of age of onset is a skewed distribution (skewed to the left), more than half of the patients having a later onset age than that given by the mean onset age.

The high mean and median age of onset could be explained as being the result of increased longevity of the general population. It may also reflect both the increased frequency of diabetes detection and the increased referral of old diabetics from the general practitioner to hospital clinics.

More people in recent years have a better chance of surviving and reaching the age zone when they will become more susceptible to diabetes. In young people hyperglycaemia is rare but in old age it is common. Carbohydrate tolerance declines with increasing age in apparently normal persons (Butterfield, 1964; U.S. Department of Health, Education & Welfare, 1964).

The experience of the Joslin clinic in 1898-1952, showed that the greatest prevalence in males was at the age of 55-59 (median 54.9), and in females at age 60-64 (median 58.3). The median age of onset in the period between 1948 and 1956 was 48.7 and 50.5 for males and females respectively. The mean age of onset was 45.5 and 46.5 for males and females respectively. In 1956 the median age of the general population in the U.S.A. was 29.9 (Joslin & Krall, 1959).

The median age of the population in Edinburgh as calculated for the mid-year estimated population in 1970, is 50.8 for males and 56.3 for females. The median age of onset of diabetes diagnosed in Edinburgh in 1970 is 61.9 and 64.6 for males and females respectively.

In the population surveys nearly all the newly diacovered diabetics were middle-aged or elderly. These studies had

Table **24**: Diabetes Annual Incidence, by age and sex, Edinburgh 1970

	All ages	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-70	80+
M A L E S										
Average annual new cases (1969-71)	145.7	3	9.3	5.3	6	15.3	29	50.3	21.3	6
Edinburgh popn.30th June,1970 (Thousand)*	219	38.6	34.2	31.5	26.9	26.7	25.4	22.6	10.1	2.8
Annual incidence per 1000 popn.	0.67	0.08	0.27	0.17	0.23	0.57	1.14	2.23	2.11	2.14
F E M A L E S										
Average annual new cases (1969-71)	172.7	23	7.3	4.7	5.7	14.7	29	58	42	9
Edinburgh popn.30th June,1970 (Thousand)*	245.8	36.3	32.5	32.3	27.2	28.7	30.4	36.6	20.1	7.8
Annual incidence per 1000 popn.	0.70	0.06	0.22	0.15	0.21	0.51	0.95	1.90	2.09	1.15
Annual incidence for both sexes	0.68	0.07	0.25	0.16	0.22	0.54	1.04	2.04	2.10	1.41

* Estimated home population, by sex and age, planning regions, hospital regions, and local authority areas, Scotland, 30th June 1970, Edinburgh City County, Annual Report of the Registrar General for Scotland, 1970, Part II, No.116, Table N.2.3 page 30.

indicated that the relative incidence of diabetes in later life is even greater than previously estimated.

Studies based on hospital patients don't necessarily deal with a representative sample; some elderly patients with mild diabetes may never be referred to hospital. Falconer, et al, (1971) have demonstrated that 54 percent of the 150 patients, who were not referred by their general practitioners, were above the age of 65 years, and 91 per cent were above the age of 45 years. Thus a higher mean and median age of onset, seen in the present study, might partly be due to higher detection of undiagnosed cases or to the inclusion of patients who, in past practice, usually were not referred to hospitals.

The effect of both these factors on the material of the present study was discussed earlier.

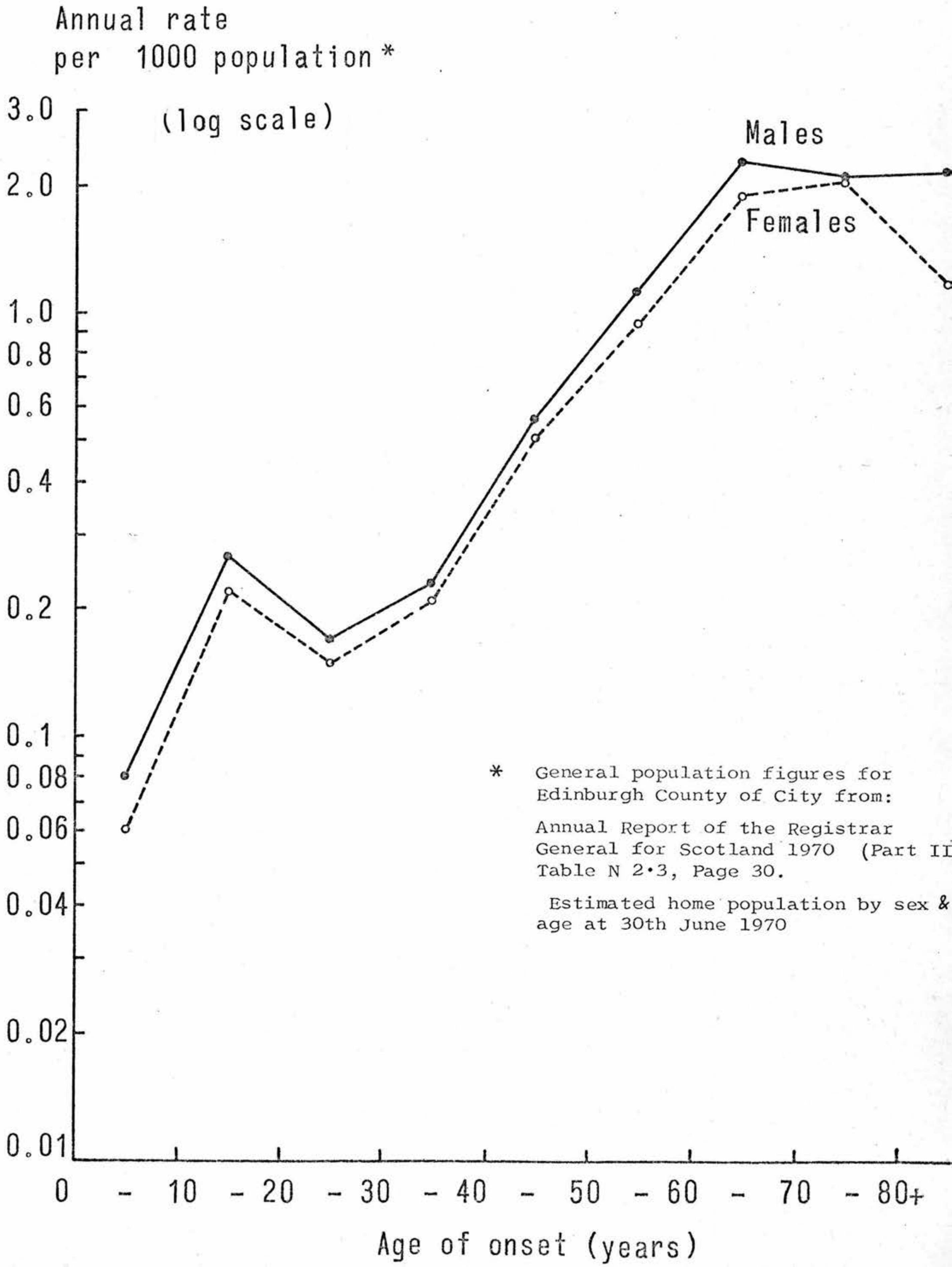
<u>Age-specific annual incidence</u>

For the distribution of age of onset of newly diagnosed diabetes to be informative, two factors have to be taken into consideration. These are: (1) the age-specific morbidity and (2) the age distribution of the general population. The fact that very few diabetics have onset after the age of about 60 years does not mean that the risk of becoming diabetic after that age is very low; it results simply from the small number of people of that age in the population. Table 24 mentions the average annual new cases diagnosed in the 3 years 1969-71; the distribution of the general population in ten-year age groups, and the annual incidence of new cases per 1000 population for each of the ten-year

Figure 7.

Diabetes. Age-specific annual incidence rates.

Edinburgh 1969-71.



age groups.

The overall annual incidence of the ascertained cases of newly diagnosed diabetics in Edinburgh is 0.68 per thousand. When the sexes are considered separately the overall incidence is not very different - 0.67 per thousand in males and 0.70 per thousand in females. Here again the sex ratio in contrast with earlier studies, where large excesses of women diabetics were found, shows a continuation of the trend towards equality. Malins (1968c), in discussing the possible causes for the changing sex ratio among diabetics, argue in favour of the possibility that it is due to a decrease among females rather than an increase among males. Although this cannot be ruled out, our results are more in line with those of Falconer, et al, (1971). They pointed out that the changing sex ratio is most probably due to an increase in male incidence rather than to a decrease in female incidence. The same trend was also observed by Hayward and Lucerna (1965).

The overall incidence for females is sightly more than that for males, but the age-specific incidence (Figure 7) shows that male incidence is more than that of females for all age groups. The higher incidence rate in males is maintained even in the older groups, in spite of the fact that female diabetics are greater in number than males in these ages.

On the logarithmic scale the increase in incidence as the age progresses is not far from being linear. There is a hump at about the age of 20, suggestive of bimodality. The possible distinctions between early and late onset diabetes from studying distribution of onset age have been suggested by other studies, e.g. Simpson (1964); Malins (1968d); Falconer et al (1971).

The age-specific annual morbidity risk curve constructed by the worker in the third study, although it does not show a clear mode at the age of 20, it shows a discontinuity which increases more slowly between 20 and 35 than it does before or after. They suggested that this might constitute a possible distinction between early and late onset diabetes.

The hump in the curve of Figure 7, is probably compatible with early and late onset diabetes being distinct entities, provided that there is an overlap of the ages of onset of the two between about 20 and 40. Nearly all cases with onset before 20 would then be of the juvenile type, and nearly all cases after about 40, of the adult type, while patients with onset of about 30 would be of both types. This suggestion fits the clinical picture, but the evidence for it is not strong enough to allow a firm interpretation.

Between the ages of 30 and 70 years, the incidence increases about tenfold. It increases two and a half fold in each 10 years, or is doubled in each 8 years. The maximum incidence occurs between 60 and 69 for males with it is 2.23 per thousand; it occurs between 70 and 79 for females when it is 2.09 per thousand. Over the age of 80 years the incidence flattened out in case of males, but falls off slightly in the case of females. This fall may be due to a small deficiency in our data of those patients who were not referred by their general practitioner.

Female diabetics of old age are more likely than younger ones to be treated by their general practitioner rather than in hospital. Nevertheless their number is apparently very small; an addition of 5 females to those in the age group above 80 years will eliminate the recorded fall in the incidence rate in that age.

In the ages contributing most heavily to new cases, age 60-79, annual rates for males ranged between 211 and 223 per 100,000, and for females between 190 and 209 per 100,000.

In contrast to the distribution of onset age, the age-specific incidence rate does not fall off in the oldest groups; it increases with age. This suggests that although the number at risk from diabetes in the general population declines with age, the risk of becoming diabetic is highest among the oldest people. Less people of the general population are found in the oldest age group, but it is among those elderly people that diabetes prevails. Distribution of onset age has been taken to indicate that virtually all "potential diabetics" have manifested their disease by the age of about 80 years. On this basis, Post (1962) has concluded that the number of manifesting diabetics found among the children of conjugal diabetics fits the single gene model for the inheritance of diabetes. Falconer, et al (1971), argue against this model because the morbidity risk curve they have drawn shows that old people still have a high risk of becoming diabetic. Post's single gene model, they suggest, would therefore tequire a larger number of diabetics than is calculated on the assumption that all "potential" diabetics have become diabetic by the age of about 80 years.

Incidence and prevalence of treated diabetes in Edinburgh

The prevalence of diabetes mellitus in Edinburgh, at 1st January 1968, was 0.65 per cent (Falconer, et al, (1971). If allowance for missed cases in the recording is made, the prevalence figure becomes between 0.66 and 0.69 per cent. The prevalence was 0.57 per cent in males and 0.67 per cent in females. The number of persons with diabetes, alive and in Edinburgh at 1st January 1968, was 3028; 150 of them were patients treated by their general practitioner and not referred to hospitals.

In the present study, the average number of new diabetics diagnosed annually is 318, and the annual incidence rate is 0.68 per thousand. To estimate the deficiency of those patients not referred from their general practitioner, the ratio between the 150 unreferred patients and the total number of 3028 diabetics, alive and in Edinburgh at 1st January 1968, could be considered. If this ratio of approximately 5 per cent is applied to our data it means that about 15 patients (5 per cent of 318 annual new cases) were not referred to hospitals and uncovered by our study. However, because of the more intimate relation between general practitioners and hospital clinics in recent years, and the tendency of referring the patients at time of diagnosis, we believe that the number of patients uncovered by our study is less than is suggested by the above estimates.

The annual incidence of 0.68 per thousand is about one-tenth or 10 per cent of the prevalence figure for 1968. Spiegelman and Marks (1946), reported that the proportion of new cases to the total prevalence in their data was 1:10. Marks, Krall & White

(1971), suggested that this ratio could be applied in estimating the incidence of new cases from the prevalence data obtained from the Health Interview Surveys in U.S.A.

The precalence of diabetes in Edinburgh at 1st January 1971, could be worked out on the basis of prevalence at January 1968, and the annual incidence of new cases over the period of 3 years. The mortality among the 1968 cohort should be considered. Unfortunately mortality statistics have been shown to be unreliable because they do not include all patients dying with diabetes. Lambard and Joslin (1936 and 1947), have investigated the death certificates of 744 diabetic patients in 1936 and 1000 in 1946, previously treated by Joslin, and found that 13.0 per cent of the first study and 9.9 per cent of the second, although dying of diabetes, were otherwise classified. 24.0 per cent of the first study and 24.6 per cent of the second, failed to have the word"diabetes" on the death certificate.

In Edinburgh, Cameron (1966) reported that in analysing 779 death certificates, only 29.0 per cent of patients, where diabetes was entered as primary cause of death, would be reported as having had diabetes in the published Scottish Mortality Statistics. 32.2 per cent, where diabetes was mentioned, but not as the primary cause, would be known to have been diabetic only from the tables of multiple causes of death published infrequently and at irregular intervals by the Registrar General. The remaining 38.8 per cent of patients, when there was no mention of diabetes, would appear in the published statistics as having been diabetic.

If one considers that published diabetic mortality for the years 1968-70* represent a third of the actual total mortality, then on the basis of the remaining cohort, in addition to the incidence of new cases in the 3 year period, the prevalence at 1st January 1971 would be 0.72 per cent.

If the published diabetic mortality figures would be considered to represent only one-fourth of the actual total diabetic mortality, then the prevalence would be 0.68 per cent. Both figures for the prevalence as at first January 1971 appears to be higher than that of 1968.

Since the introduction of insulin, deaths from diabetes in individuals under 50 years of age have shown a marked decline, and this has been especially prominent in the case of those with childhood onset.

The increasing duration of life of diabetics is one factor which might be instrumental in accomplishing a real increase in the prevalence of diabetes. Other factors are ageing of population, and increased prevalence of obesity.

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* Annual Reports of the Registrar General for Scotland, Part I, Nos. 114, 115 & 116; Table C2. 15: Death by sex, age, cause and local authority area, Scotland, for 1968, 1969 & 1970.

P A R T III

SOCIAL AND MEDICAL CHARACTERISTICS OF DIABETICS

SOCIAL AND MEDICAL CHARACTERISTICS OF DIABETICS

Status of patients at end of observation period

Encouraging results were observed as a result of following patients diagnosed in 1969-71 period, till the end of 1972, Table 25, (Table 7 in the Appendix shows the distribution of patients according to year of diagnosis)

Table 25: Status of 775 patients at 31.12.72 by sex and age at diagnosis

	All ages			0-19		20-39		40-59		60-79		80+	
Status	Both	M	F	M	F	M	F	M	F	M	F	M	F
Alive	669	298	371	32	26	35	23	103	108	121	199	7	15
Defaulted	10	6	4	0	0	1	1	3	0	2	2	0	1
Dead	96	46	50	0	0	1	3	7	6	34	38	4	3

Only 10 (1.2 per cent) out of the 775 patients studied, defaulted from attending the Royal Infirmary. Information abou t them thus could not be completed for the entire period of follow-up. Three of them chose to attend private physicians. Three others emigrated. Two patients were found to have moved from the locality, one to Glasgow and the other to Somerset. The control of one patient was undertaken by the medical officer of a prison. A mentally handicapped patient was controlled in Gogarburn Hospital. All ten patients were diagnosed during 1969-71 period "No duration".

96 (12.6 per cent) patients (46 males and 50 females) died during the follow-up period. 79 of them were above the age of 60 years. 81 of the 96 dead patients were diagnosed during 1969-71 period, and the other 15 were patients with "duration".

Table 26: Status at 31.12.72 according to "Duration" by sex, 1969-71

Status	No Duration		With Duration	
	MALES			
Alive	252		46	
Defaulted	6		0	
Dead	41		5	
Total	299		51	
	FEMALES			
Alive	329		42	
Defaulted	4		0	
Dead	40		10	
Total	373		52	
	MALES and FEMALES			
	No Duration		With Duration	
	Number	%	Number	%
Alive	581	86.5	88	85.4
Defaulted	10	1.5	0	-
Dead	81	12.0	15	14.6
Total	672		103	

669 (86.2 per cent) were alive at 31st December 1972. Of these, 581 were diagnosed during 1969-71 period "No duration", while 88 had a "duration" of one or more years between onset and their first attendance (Table 26). (Table 8 in Appendix illustrates status according to duration.)

Analysis on dead patients will be discussed later in this part.

Because of the small number involved in each of the categories in the "duration" group of patients, they will be dealt with as one group.

Table 27 shows the age and sex distribution of both 672 newly diagnosed "No duration" and the 103 "Duration" patients. Younger age groups are represented more among the "Duration" than among the "No duration" patients. 21.4 per cent of "Duration" patients are below the age of 20 years, while only 5.7 per cent of "No duration" patients are in that age group. This is because the majority of diabetic children attending the diabetic clinic of the Royal Hospital for Sick Children are being referred to the Royal Infirmary clinic when reaching adulthood.

Table 27/

Table 27: Age and sex distribution of 775 patients according to "Duration" before attending the clinic, 1969-71

Sex	AGE AT DIAGNOSIS					
	<20	20-39	40-59	60-79	80+	All ages
	"NO DURATION"					
Males	21	27	95	146	10	299
Females	15	22	99	218	19	373
Both sexes	36	49	194	364	29	672
Per cent of total	5.4	7.3	28.9	54.2	4.3	100.1
	"DURATION"					
Males	11	10	18	11	1	51
Females	11	5	15	21	0	52
Both sexes	22	15	33	32	1	103
Per cent of total	21.4	14.6	32.0	31.1	1.0	100.1

Type of diabetes

There is no satisfactory method available at present, either for the classification of diabetes mellitus or for the purpose of determining the severity of the disease. Joslin (1959b), stressed the fact that the nature of the disease may frequently undergo modification in the same individual at different periods. He said: "A diabetic may be mild, moderate, or severe largely as the doctor with his diet, insulin and exercise makes him."

There have been many attempts to classify diabetic patients by their physique, their age, their need for insulin, or the supposed site of the lesion responsible for their diabetes. Even today very little is known about the causation of diabetes in the great majority of patients, and a classification of aetiology is not practical. Descriptive classifications are more useful.

The response to insulin was used by Falta (1963), to distinguish insulin-sensitive from insulin-insensitive cases, the groups correspond roughly with those of juvenile and maturity onset diabetes. The use of insulin-g;ucose tolerance test was elaborated by Himsworth (1939 and 1949). Falta and Himsworth have described two broad types of diabetes:

1) The "insulin-sensitive" type. Clinically the patients in this group are rapidly responsive to insulin, and are subject to both hypoglycaemia and ketosis; and

2) The "insulin-resistant" type. The patients are clinically less responsive to insulin and are much less liable to either of these complications.

The insulin-sensitive type, requires little insulin to prevent the excretion of many grammes of urinary sugar, and tolerates little or no increase of insulin dosage without showing hypoglycaemix symptoms, and reacts to withdrawal of treatment by profound glycosuria. The patients tend to be young, thin, with non-arteriosclerotic arteries with normal blood pressure. The onset of the disease is uaually sudden, and tends to be severe.

The insulin-resistant type, on the other hand, requires many units of insulin to deal with each gramme of urinary sugar, tolerates many units of insulin above the dose required to keep the urine free of sugar, and on cessation of treatment, shows little or no glycosuria. The patients in this group tend to be obese, the disease is milder and the onset is often insidious. Arteriosclerosis and hypertension are commonly associated with this group of diabetes.

Draper, Dupertuis and Caughey (1944), and Lister, Nash and Ledingham (1951) linked these two types with two constitutional types of diabetes, type 1 being more linear in form than type 2, who were heavier and whose form was rounded. Type 1 patients were generally severe diabetics, but insulin-sensitive, becoming ketosed with poor control. Type 2 patients were generally less severe, but insulin-resistant, and having little tendency to ketosis or hyperglycaemia.

Lawrence (1951) further sub-divided the insulin-resistant type into two sub-divisions, depending on the absence or excess fat stores, into lipoatrophic and lipoplethoric diabetes.

Since Franke and Fuchs (1955) reported the use of carbutamide, a sulphonylurea compound, the use of oral hypoglycaemic drugs has become a common practice. In Edinburgh, one-third of patients studied by Falconer, Duncan and Smith in 1968, were treated with oral hyperglycaemic agents. In 1963, in the Birmingham General Hospital clinic, 30 per cent of all those attending were prescribed sulphonylurea drugs (Malins, 1968e), and a similar figure was reported from the U.S.A. (Beaser, 1964). Porter (1974) has shown that 44 per cent of diabetics attending the Royal Infirmary Diabetic Clinic in Edinburgh, were on hyperglycaemic agents.

Patients well controlled on oral drugs should naturally be considered as insulin independent, because it has been shown that patients who respond best to the action of sulphonylurea drugs are those in whom there is a strong evidence of a capacity for endogenous insulin production (Duncan & Baird, 1960). However, because they constitute more than a third of the total number of patients, and for the purpose of the present study, the patients have been divided into three main groups;

1) Those who were dependent on insulin.
2) Those who required oral hyperglycaemic agents for stabilizing, and
3) those who could be stabilized by dietetic restriction alone.

Those treated by diet alone or an oral hyperglycaemic agent were advised to avoid sweet foods and to take "starch" foods in moderation. If these restrictions were ineffective, carbohydrates were more specifically limited by designating the allowances in terms of domestic measures; for the obese, fat was similarly restricted. Initially at least, most insulin-taking diabetics were given weighed amounts of carbohydrates, using an exchange system.

Oral treatment was either by sulphonylurea or biguanide compounds or both.

Insulin-dependant patients were treated by insulin from the several available preparations, given by single or twice daily injection. Biguanides occasionally had been added to those insulin-taking young patients, who became increasingly obese and uncontrolled with large doses of insulin.

Patients, especially those with obese, maturity onset, would be tried on a dietary regime at the start. Very occasionally a newly diagnosed, obese diabetic would show considerable ketonuria and required insulin, although usually only temporarily. On dietary regime, further treatment depended largely on whether or not the patient has adhered to the diet and has responded well to it. Initially, patients were advised to report to the clinic every two weeks and then at intervals of four to six weeks until satisfactory control was established. In some patients, especially those who were obese, the glycosuria rapidly and completely disappeared within a week or two, even before there has been any appreciable loss of weight. Final response to treatment became apparent within one to six months. Some patients rapidly attained their standard weight but continued to show persistent glycosuria and hyperglycaemia. They required treatment with a hyperglycaemic agent, or because this failed, with insulin. A number of patients, however, did not lose enough weight and continued to show considerable glycosuria. This might have been due to failure to adhere to the diet or to increasing severity of diabetes. Their diabetes control necessitated the introduction of either oral agent or insulin.

Many non-obese diabetics became well controlled within a few weeks on diet alone. The response to diet was usually assessed in a shorter time, and additional treatment with oral agent or insulin was advised in some patients because of poor response to diet. Some patients initially treated by oral hyperglycaemic agent were seen later to need insulin therapy to control their diabetes.

A few patients who, because of intercurrent illness or stress, needed insulin at time of diagnosis, were seen to be adequately controlled by diet or oral agents on cessation of their infections or stresses.

Table 28 shows the number and percentage of patients according to "initial" treatment, and the regime they have been regulated by: the "established". It should be noted that the treatment of each patient is kept under constant review, and the "established" treatment is a term used to describe the patients' regime in the period under study (1-4 years).

Table 28: Distribution of patients according to the type of initial, and established treatment

Treatment	Insulin		Oral		Diet	
	No.	%	No.	%	No.	%
	MALES					
"Initial"	64	18.3	81	23.1	205	58.6
"Established"	74	21.1	135	38.6	141	40.3
	FEMALES					
"Initial"	60	14.1	133	31.3	232	54.6
"Established"	66	15.5	230	54.1	129	30.4
	BOTH SEXES					
"Initial"	124	16.0	214	27.6	437	56.4
"Established"	140	18.1	365	47.1	270	34.8

The majority of patients over the age of 40 (Table 9 in the Appendix) were started on dietary control as most of them were overweight. The greatest change in regime, occurred in those initially controlled with diet only. Initially, in both sexes, more than half of the patients were tried on diet alone; about one-third on oral hypoglycaemic agents. When the "established" regime is considered, this is reversed. 47 per cent of patients had oral drugs as an established therapy, while only 34.8 per cent remained adequately controlled on diet. The change to oral hypoglycaemic agents was more marked in the case of females than males; 22.8 per cent of females were added to those initially started on oral agents, in males the corresponding figure is 15.5 per cent. About half of the females (63 patients) in the age group 60-79 who were on diet alone, changed to oral therapy (Table 9 in Appendix).

Insulin-dependent patients increased only slightly. 16 per cent of patients of both sexes were started on insulin. At the end of the observation period, 18.1 per cent were shown to be adequately controlled on insulin. In this case, proportionally more males than females had changed to insulin as their "established" treatment.

It is being increasingly realised that a considerable proportion of patients take little or no cognisance of the dietary advice they have been given (Tunbridge & Wetherill, 1970). Although cost may occasionally be a factor, Hawkins (1970) suggested that an over-complicated and unnecessarily strict dietary regime might also be important.

Some obese patients who cannot or will not eat less, do not lose weight, and have persistent glycosuria and symptoms. Some others, although reaching their correct weight continue to have glycosuria, hypoglycaemia and possibly, symptoms, and are true dietary failures.

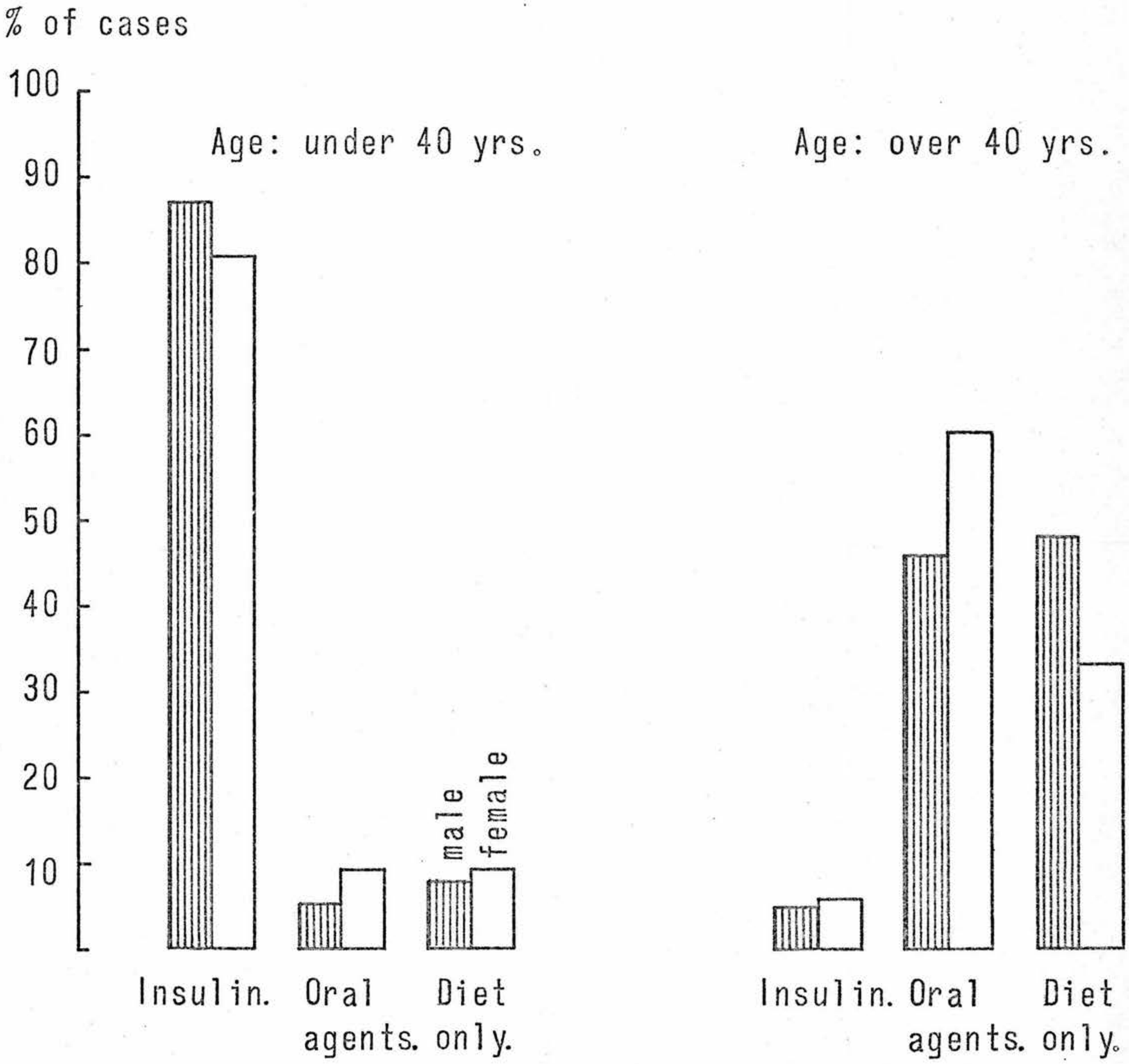
Malins (1968f), believes that there is a tendency for mild diabetes to become worse, either gradually or in a step-wise fashion, as a result of stresses or infections. He suggested that many patients pass through the stages of successful diet, sulphonylurea with biguanide, and eventually insulin, the whole sequence taking ten or more years.

The higher proportion of patients in our study who are on oral drugs or diet alone, could be due to the fact that the majority of our patients are newly diagnosed diabetics and that even their "established" treatment might be considered as a stage towards complete islet cell exhaustion. When considering the "established" regime, there is a higher proportion of patients on insulin and oral hypoglycaemic agent among the "duration" group of patients than among those who were newly diagnosed ("No Duration") in 1969-71. (Table 10 in Appendix).

Table 29 gives the established treatment according to age and sex. All males and all females but one, in the age group below 20, were insulin-dependant. 54.1 per cent of males and 65.7 per cent of females in the age group 60-79 were stabilised on oral hypoglycaemic agents. Diet controlled male patients predominate in the age group 40-59 years.

Figure 8.

Diabetic patients; distribution according to 'established' type of treatment.



For females starting at the age of 40, those controlled on oral drugs were in excess of those controlled by diet alone or insulin. This is more clearly shown in Figure 8. 60.5 per cent of females above 40 years were on oral hypoglycaemic therapy, with only 46.6 per cent of males needing such treatment. In this age group, males exceeded females among those controlled by diet only.

Table 29: Established treatment according to age and sex, 775 patients

Age at Diagnosis	Insulin		Oral		Diet	
	No.	%	No.	%	No.	%
	MALES					
< 20	32	100	0	-	0	-
20 - 39	28	75.7	4	10.8	5	13.5
40 - 59	11	9.7	42	37.2	60	53.1
60 - 79	2	1.3	85	54.1	70	44.6
80+	1	9.1	4	36.7	6	54.5
All ages	74	21.1	135	38.6	141	40.3
	FEMALES					
< 20	25	96.2	0	-	1	3.8
20 - 39	18	66.7	5	18.5	4	14.8
40 - 59	14	12.3	55	48.2	45	39.5
60 - 79	9	3.8	157	65.7	73	30.5
80+	0	-	13	68.4	6	31.6
All ages	66	15.5	230	54.1	129	30.4

Oral hypoglaemic drugs now have an established place in the treatment of diabetes. In properly selected cases, symptoms are relieved, and also hyperglycaemia and glycosuria. The possibility of adverse effects resulting from the long-term use of these drugs was considered from the time of their introduction 20 years ago, when it was also acknowledged that only time would reveal whether the development of the late vascular complications would in any way be affected by their use. The University Group Diabetes Programme (UGDP) in the U.S.A. was established to throw light on these problems, and the current debate on the safety of these drugs has largely arisen as the result of the report of their prospective study (UGDP, 1970). The report suggested that the long-term use of tolbutamide might be associated with a marginally but statistically significant increased risk of cardiovascular mortality. Phenfarmin, a biguanide compound, has also been suspected (Knatterud, et al, 1971). However, the general consensus in the United Kingdom is that the findings are difficult to interpret since the numbers of patients were relatively small, and many of them were mildly diabetic and could have been controlled by diet alone (Clarke & Duncan, 1971; 1972; Lister, 1972).

They argue that it is not surprising that 26 of the 30 deaths in the 204 tolbulamid-treated patients over a 5 to 8-year period were attributed to cardiovascular factors, since most of these patients were in the older age group in which atherosclerotic disease is the main cause of death. Moreover, Keen and Jarrett (1970), reported contradictory results from the study of borderline diabetics discovered in the Bedford survey. They found that these patients show an enhanced risk of developing athersclerotic cardiovascular disease, which appeared to be reduced in a group treated with tolbutamide. Passikivi (1970), in Sweden, also reported contradictory findings. He carried out a prospective study on a group of patients found to have impaired glucose tolerance, after sustaining cardiac infarction. After their recovery they were randomised into two groups; one treated with placebo, and the other with tolbulamide. The latter group had an improved survival over 18 months following their first myocardial infarct. In the Joslin clinic retrospective study (Marble, 1971c), preliminary analysis of causes of death among 1625 patients known to have died during the years 1956-1969, showed that deaths from coronary heart disease occurred with almost the same frequency among those who had been treated with sulphonylurea as among those treated with insulin.

Butterfield (1971) suggested that either the UGDP cases were overweight and hence not really suitable for tolbutamide treatment, or if not obese, had suffered diabetes of a severity where prolonged oral therapy should not be countenanced. The findings have also been criticised by many others for many reasons (British Medical Journal, 1970; Constam, 1971; Lancet, 1971c; Bloom, 1972; Seltzer, 1972), in particular for the reason that many of the subjects in the American trial were borderline diabetics of the type usually treated in this country by simple dietary restriction, without recourse to oral hypoglycaemic agents.

Tomkins and Bloom (1972) reported the result of a trial in which hypoglycaemic agents were replaced by placebos in diabetic patients attending Whittington Hospital clinic. In the case of 43 out of 62 patients hypoglycaemic agents were replaced within six months, but blood sugar control remained unchanged in 19 (31 per cent) during a period of observation (until relapse occurred, or for a minimum of six months). This suggests that even when the need for tablet therapy has been established by a poor initial response to simple dietary restriction (the 62 patients who were included in the trial were such patients), the introduction of tablets should not be regarded as necessarily permanent.

The practice in the Dietetic Department of the Royal Infirmary, Edinburgh, is to introduce tablets only when simple dietary restriction has failed to restore normoglycaemia. The dose was under constant review, and in some cases has steadily been reduced and even discontinued if normoglycaemia was maintained, to be reintroduced only when hyperglycaemia recurs.

Until their lack of safety is proven by further evidence, the oral hypoglycaemic agents should continue to be used for the patients with symptoms of glycosuria and hyperglycaemia, who are insulin-independent, but failed to be controlled on diet alone, to spare these patients the necessity of daily insulin injections, close adherence to a restricted dietary regime, and also the exposure to greater risk of hypoglycaemia. However, their use should be kept under constant medical supervision.

Studies which have been done before the introduction of sulphonylurea in 1958, had shown that the majority of patients were treated by insulin. For example, in the series of patients studied by Andrews (1957), only 18 per cent of the patients were found to require no insulin, whereas 37 per cent of all patients required one type of insulin and the remaining 45 per cent had to receive two types of insulin to maintain adequate control.

Vartianen and Vartianen (1944), reported that 76.6 per cent of the male diabetics, and 68.7 per cent of all female diabetics in Finland were taking insulin at the end of 1942. Consett (1959) reported that 29 (15.3 per cent) out of a total of 189 patients treated at a medical unit in Natal were controlled by diet alone. The remaining 84.7 per cent required varying amounts of insulin to maintain adequate control. A characteristic feature, which is perhaps shared by other diabetics from the tropics, was observed in these Indian diabetics. Considerably large proportions of them were relatively insulin-resistant, and required large amounts of insulin in order to maintain adequate control. 102 patients out of 160, who were controlled on insulin, required more than 50 units of insulin per day. The majority of the diabetic patients in England and Wales require less than 50 units of insulin to maintain adequate control (Stocks, 1949).

In the present study the patients on insulin were divided into two: those who required less than 40 units of insulin daily, and those who required more than 40 units per day (Table 30).

Both among males and females, the majority of "duration" patients required more than 40 units of insulin. This is probably due to the fact that a larger proportion of "duration" patients were of younger age group, and used insulin for a longer period than did those who were newly diagnosed in 1969-71 period (Table 11 in Appendix).

Table 30: Insulin dosage in 140 insulin-dependant patients, in both "Duration" and "No duration" groups (per cent)

	MALES		FEMALES	
	"No Duration"	"Duration"	"No Duration"	"Duration"
< 40 units	58.3	38.5	52.4	37.5
40+ units	41.7	61.5	47.6	62.5
No. of patients	48	26	42	24

Weight at onset of diabetes

The close relationship between obesity and maturity onset (insulin-independant) diabetes, although long recognised (Joslin, Dublin & Marks, 1935), remains ill-understood. Diabetes is most frequently diagnosed between the ages of 40 and 70, the majority of these patients being significantly more overweight than correspondingly aged non-diabetics (Pyke & Please, 1957; Fowler, Butterfield & Acheson, 1970). Obese people have been shown to have abnormalities related to carbohydrate metabolism, which are usually of a mild nature, and insulin secretion. Diabetes occurs more frequently in these obese people than in the general population.

It has been shown by insurance statistics that the heavier an individual is at the time of his insurance examination, the more likely is he to develop diabetes in later life (Dublin & Marks, 1930; 1937; 1938; Murphy, 1956).

Joslin, Dublin and Marks (1936), in analysing the case records of 4596 diabetics, found that 78.5 per cent of the males and 83.3 per cent of the females were overweight (i.e. 5 per cent or more above the average weight for age at time of their maximum weight.) The weight at onset of diabetes, however, gave somewhat lower figures. Of the 3094 for whom these data were available, 62.7 per cent of the males and 67.4 per cent of the females were found to be overweight. Moreover, one-half of the men and approximately 60 per cent of the women were observed to be at least 20 per cent overweight at their maximum weight. No less than 16.5 per cent of the men and 25.8 per cent of the women were 40 per cent or more overweight at their maximum. In contrast to this, only 7.9 per cent of the diabetic men and 6.3 per cent of the diabetic women had always been underweight, (5 per cent or more less than average for age), and less than 1 per cent had always been 20 per cent or more overweight. In 2000 of Joslin's clinic cases of diabetes, not one occurred in a person who was more than 30 per cent underweight, and in the Mayo clinic series, no patient developed diabetes who was more than 20 per cent underweight.

Among men who were approximately 20 per cent overweight at time of acquiring a life insurance policy, there was an excess mortality of 133 per cent associated with diabetes. Among a similar group of women the excess mortality rate associated with diabetes was 83 per cent. (Metropolitan Life Insurance Company, 1960 a and b).

Both non-diabetic obesity and diabetes, irrespective of weight, are associated with shortened longevity often due to cardiovascular disease. Recent insurance statistics have shown that non-diabetic people who are 20 pounds or more above their standard weight have at least a 25 per cent greater mortality than those of normal weight (Society of Actuaries, 1959).

Pell and D'Alanzo (1970), found that diabetics have a two and a half times greater mortality than non-diabetics of similar age. They have demonstrated that the increased mortality incurred by the presence of hypertension, coronary artery disease, and obesity, was no greater among the diabetics than the non-diabetic controls, and some of the excess mortality was because these conditions were more common among diabetics. However, they have shown that even when these factors were not present, diabetics still had a substantially greater risk of death than non-diabetics, and it seems clear that obesity and diabetes make a bad combination in respect of longevity.

Nearly all authors are unanimous in the indictment of obesity as a precipitating factor in the onset of diabetes (Joslin, 1959a; Finberg, 1960; Williams, 1968b). Williams stated: "More than two-thirds of those with adult-onset diabetes are obese and tend to remain obese. Approximately 40 per cent of those with adult-onset diabetes are overweight at the time that diabetes is diagnosed, compared to a 10 per cent incidence of obesity in non-diabetics". Furthermore, Williams has pointed out that the greater the obesity the higher the incidence of diabetes. Diabetes appears to be largely a penalty of obesity, and the greater the obesity the more likely the penalty to be exacted.

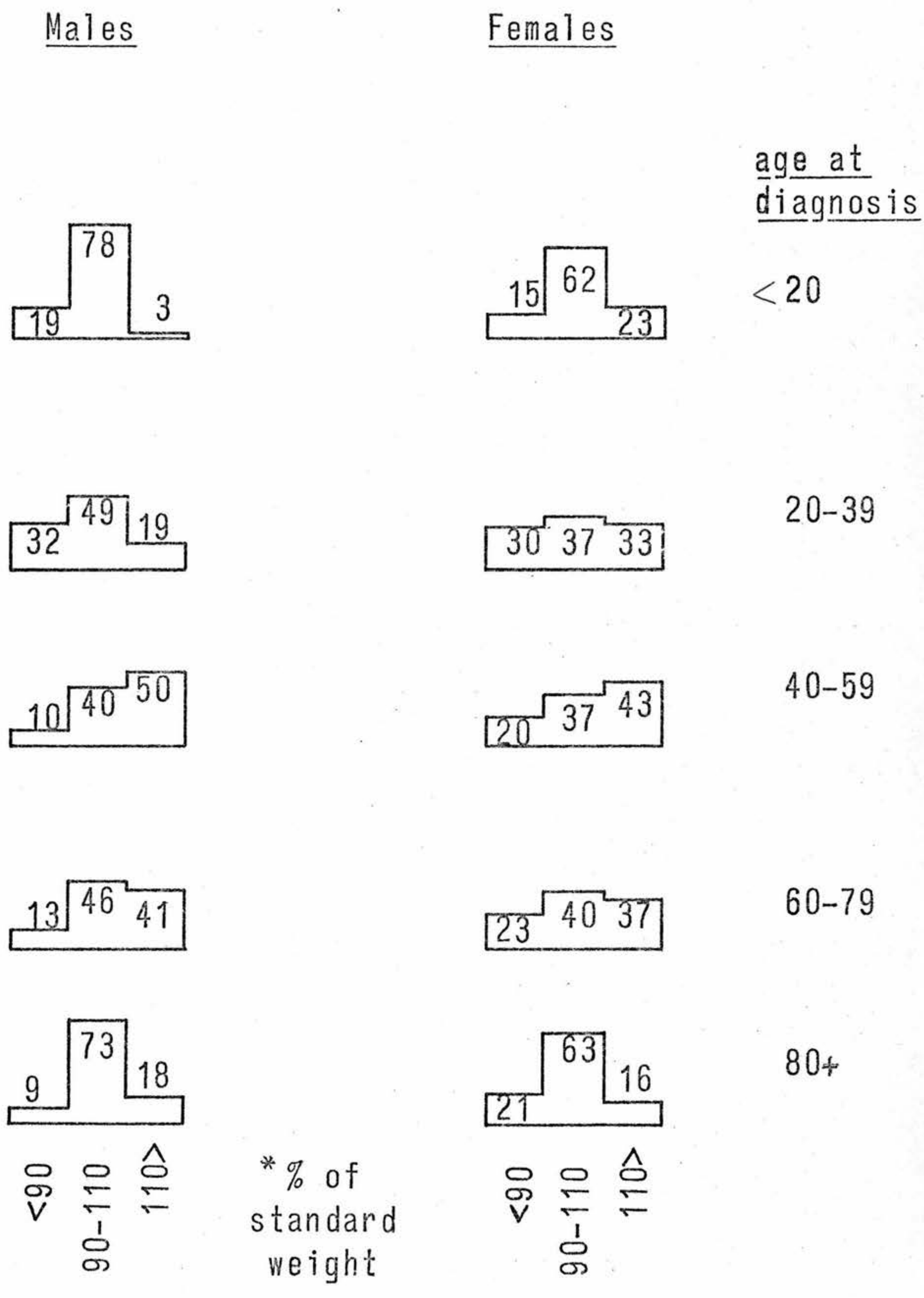
World War II provided ample evidence that in those countries where there was food deprivation, notably Japan, there were apparent concurrent decreases of obesity and incidence of diabetes. (Goto, Nakayama & Yagi, 1958). Himsworth (1949), and Newburgh and Conn (1939), had demonstrated that carbohydrate tolerance may be restored to normal by weight loss. This supports the theory that obesity may lead to diabetes. However, in a recent study of 100 diabetics (Pyke, 1968b), who were overweight by at least 15 pounds, it was found that diabetic control, as measured by degree of glycosuria, was as good in those who did lose weight as in those who did not. Mere carbyhydrate restriction rather than loss of weight might have been the cause of the amerioration of the diabetes in these fat patients. Rudnick and Taylor (1965), studied the blood glucose and serum insulin level in 8 mild diabetics, treated by dietary restriction only. In 7 patients, glucose improved and serum insulin response to glucose challenge increased over a period of four months of successful dietary treatment, suggesting an improvement in the capacity of the pancreas to secrete insulin. Proper management of patients would obviously save the obese-non-diabetics from the danger of early development of symptoms of overt diabetes. Of all the factors precipitating diabetes, obesity is by far the most important. Fortunately, this factor is preventable.

The causation of obesity is complex and apart from the obvious imbalance between calorie intake and output, as yet undefined, metabolic abnormalities together with genetic factors must be involved (Mayer, 1965). Studies of subcutaneous tissue obtained by biopsy, shows that adipose tissue cells are increased both in size and number in long-standing human obesity and that, following successful weight loss, the hypercellularity persists although there is a marked reduction in cell size (Salans, et al, 1968). The cellularity of fat depots seems to be largely determined in early life, particularly by eating habits and possibly also by genetic factors, and thereafter remains fairly constant. Many studies (Karam, et al, 1963; Beck et al, 1964; and Yellow, et al, 1965), supported Ogilvie's demonstration in 1933, that pancreatic islet tissue showed marked hyperplasia and hypertrophy in non-diabetic obese subjects. These studies and many others (e.g. Cerasi and Luft, 1967; Seltzer, et al, 1967; Bagdade, et al, 1967; Sims, et al, 1968; McKiddie, et al, 1969; Abrams, et al, 1969 and Nikkilä and Taskinen, 1971), have shown that obesity characteristically results in peripheral insulin resistance with compensatory hyperinsulinism, both in the fasting and post-absorptive state, which correlates with adipose cell diameter. Obesity is a major factor in precipitating diabetes but only in those who are genetically predisposed, with a defective pancreatic B cell mechanism for insulin secretion. The former view that obesity may be the result of the diabetic genotype is no longer tenable, though there is some evidence that the diabetic state may alter the distribution of subcutaneous fat. This subject has been discussed in some detail in Part I.

Although a great deal of evidence has been presented and many theories promulgated to explain and illustrate the association between obesity and diabetes, precise data are still lacking on the extent of obesity. In the United Kingdom it seems that its prevalence is high and steadily increasing, especially in males (Montegriffo, 1971). Like its prevalence, obesity presents difficulties in definition. Normally fat makes up 15 per cent of the body weight in young men, and 25 per cent in young women, the latter having a larger amount of adipose tissue per kilogram body weight than men of the same age. So-called 'simple' obesity is an excessive accumulation of fat in the body storage areas of people who have no specific predetermining condition. The degree of obesity is often difficult to assess, and factors such as race, age, sex, height, skeletal and muscle mass, and general body habits, have to be considered. In the Diabetic Department of the Royal Infirmary of Edinburgh, the weight of patients was standardised according to weights for age, sex and height data of the United States Medico-Actuarial Society (1912). These data are the height and weight of 221,819 men and 136,504 women of fifteen or more years of age. In men, the

Figure 9.

Distribution of weight among 766 diabetics at different ages. Figures are given for the number (percent.) of patients in each age group who are underweight, middleweight and overweight.*



mean increase in weight between the ages of 24 and 54 is about 10 per cent, in women it is 14 per cent.

For 775 diabetics studied, the weight at time of first attendance was known in 766 of them. Table 31 and Figure 9 show the weight expressed as a percentage of the standard weight for age and height. The weight recorded was at time of first attendance. (Table 12 in the Appendix shows the weight distribution according to "Duration").

It will be observed that obesity as such is not an important factor in the younger age groups, as shown by the fact that the percentage of individuals who were 10 per cent or more above their standard weight in the age group below 20 years, was 3 per cent and 23 per cent for males and females respectively. Over the age of 20 the proportion of overweight patients increases, The majority of patients (50 per cent and 43 per cent of males and females respectively) in the age group 40-59 years, were above 10 per cent of their standard weight. A similar proportion of patients aged 60-79 were overweight by the same amount.

It is probably due to the data used for standardisation (U.S.Medico-Actuarial Society, 1912), that in the older age groups (60-79 and 80+) there were diminishing proportions of overweight patients. These data give average weight for a given height for each individual's age (in years), from the age of 15 to 55. In the Diabetic Department, diabetic patients older than 55 years, were assumed to be of that age and their standard weight was calculated on this assumption. Although in the general population there is a trend of increased obesity with increasing

Table 31: Distribution of patients according to weight at time of first attendance by age and sex: 775 patients: 1969-71

Weight as per cent of standard weight	All ages				Age at first attendance									
	Males		Females		< 20		20-39		40-59		60-79		80+	
	No.	%	No.	%	M	F	M	F	M	F	M	F	M	F
< 90	50	14.3	94	22.1	6	4	12	8	11	23	20	55	1	4
90-	85	24.3	85	20.0	16	9	11	5	20	15	33	50	5	6
100-	83	23.7	89	20.9	9	7	7	5	25	27	39	44	3	6
110-	51	14.6	62	14.6	1	3	3	2	22	14	23	41	2	2
120-	38	10.9	37	8.7	0	3	2	1	14	11	22	22	0	0
130-	22	6.3	24	5.6	0	0	1	2	11	11	10	10	0	1
140+	18	5.1	28	6.6	0	0	1	4	9	12	8	12	0	0
N.K.	3	0 .9	6	1.4	0	0	0	0	1	1	2	5	0	0
Total	350	100.0	425	100.0	32	26	37	27	113	114	157	239	11	19

age, data from Pyke and Please (1957), shows a slight decrease in the proportion of overweight persons, especially in women over the age of 70 years. Moreover, the weight of diabetics at time of diagnosis differs from that of maximum weight or the weight after treatment. The weight at diagnosis (for the majority of patients the weight at first attendance was that at diagnosis) tends to under-estimate the actual weight, because diabetics usually lose weight at the onset of the disease and shortly after that, following the dietary advice more closely at the start of their illnesses. Their weight before the onset and after being newly diagnosed, tends to be more than that at time of onset (Joslin, Dublin and Marks, 1936).

Pyke and Please (1957), observed the weights of 946 diabetics at the Radcliffe Infirmary and compared them with that of normal control. They have noticed that not only does the mean weight of older diabetics exceed the normal, but there was a striking excess of diabetics who are more than 10 per cent overweight at time of diagnosis (Table 32).

Table 32: Number (per cent) of diabetic and normal men and women exceeding 110 per cent of mean normal weight*

Age	MEN		WOMEN	
	Diabetic	Control	Diabetic	Control
15 - 30	13	12	20	18
30 - 40	29	14	43	23
40 - 50	43	18	51	26
50 - 60	48	21	53	27
60 - 70	44	22	55	27
70+	55	23	55	26

* Source: Pyke, D.A. and Please, N.W. (1957): Obesity, Parity and Diabetes, J.Endocr., 15, xxvi.

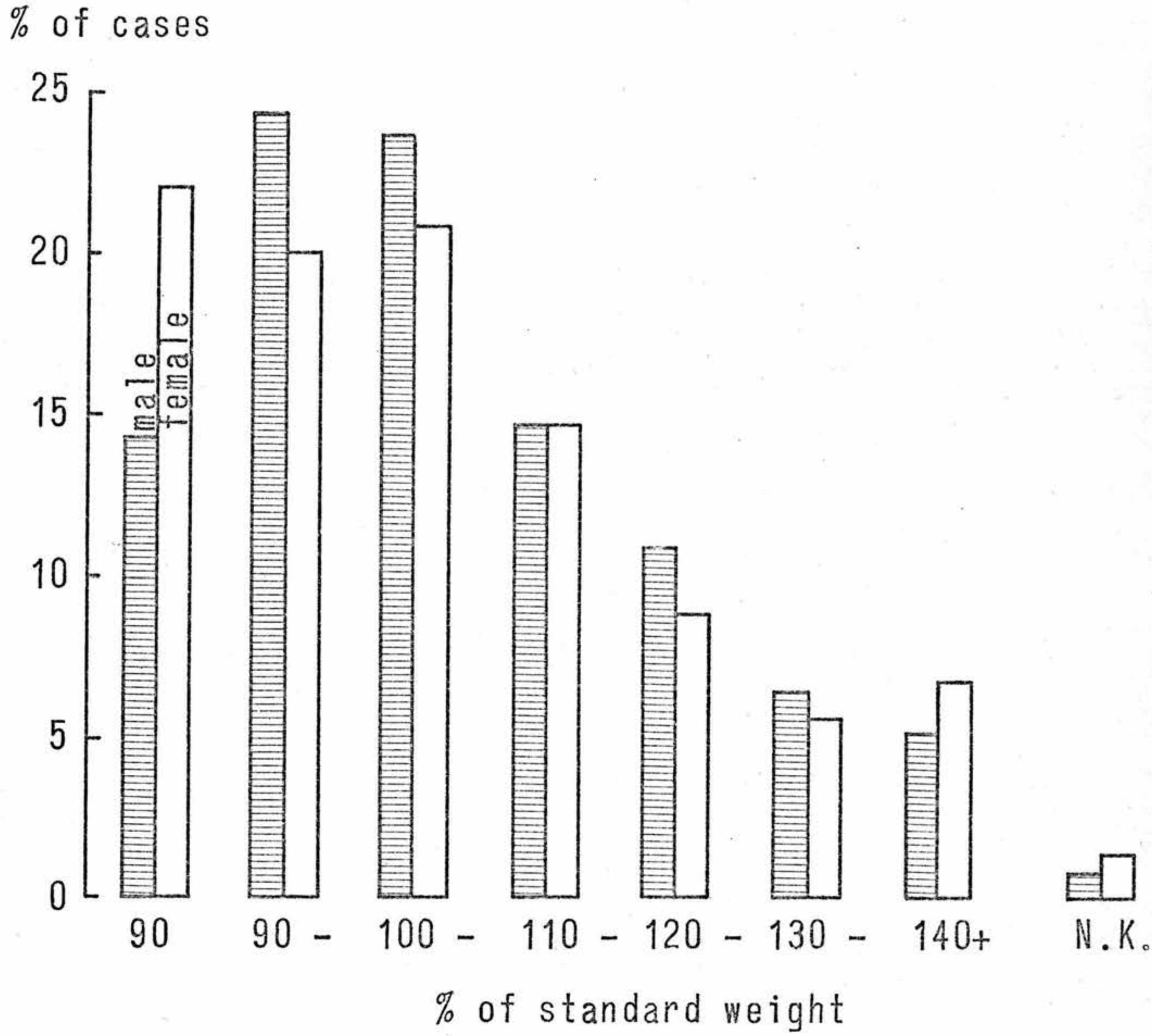
Among diabetics under the age of 30, the number who are overweight is little greater than among non-diabetics, but among older patients the percentage rises sharply. Over the age of 40 for women and 50 for men, about half of diabetics are more than 10 per cent overweight as compared with only a quarter of controls, but thereafter there is little further increase. In diabetic children aged 4-15, the mean weight at diagnosis is less than that of normal controls, by approximately 10 per cent (Danowski, 1957).

If diabetics were no heavier than non-diabetics, the number of diabetics who exceed 95 percentile or normal persons' weights should be about 5 per cent. This was the case among young diabetics studied by Pyke and Please. But after the age of 30 years the figure is much higher; 21-23 per cent for men and 16-21 per cent for women. They explained why more men than women diabetics exceeded the 95th centile as being due to the fact that there is a greater spread about the mean in normal women than in normal men. It requires a smaller relative excess of weight for a man to exceed the 95th centile than for a woman to do so.

In the present study for all ages, the percentage distribution of weight (expressed as percentage of normal weight) of 766 patients for whom the weight at first attendance was known, is shown in Figure 10. Males exceeded females in the normal weight range, i.e. with 10 per cent of their standard weight. There was an excess of about 8 per cent of females over males in the underweight zone. Moreover, males were slightly exceeding females in the

Figure 10.

Diabetic patients: distribution by weight at first attendance. 775 patients. Edinburgh 1969 - 71



overweight range, by about 1.4 per cent for those overweight by 10 per cent and more. The clinical impression that diabetic women are more obese than diabetic men is presumably due to the fact that normal women gain more weight with age than do normal men.

The frequency distribution curve studied by Pyke and Please (1957) of the weight of 946 patients (each expressed as a percentage of normal weight for a person of the same sex, age and weight), does not show any double peak. This also can be seen from Figure 10 of our data.

If the thin ketosis-prone type is really distinctive from the fatter type with little tendency to ketosis, the overlap in terms of weight is so great that there seems to be no natural division between them. Thus, in terms of weight, there is no evidence of two distinct types of diabetes. The two curves which might be assumed to be submerged in one single curve, must have their peaks so close together, closer in fact than would allow a clinical distinction to be made between them.

Marital status in diabetics

In discussing marital status of diabetic patients, it should be remembered that marital status and diabetes mellitus are two processes. It is difficult to separate them because both are continuous in nature, with a tendency to change with time. The relation between the two is as yet not fully understood. Most studies deal with the possible effect of marital status on diabetes, whereas the effect of diabetes on marital status has not been studied fully. Thus many questions remained with no definite answer, such as: Is diabetes a factor in a divorce which takes place after the discovery of the disease in one partner? Or, by reason of impotence, for example, does the existence of diabetes in a young person play a role in keeping him single? The answers to such questions will clearly help to clarify the relation between the two, but are outwith the scope of the material in the present study.

The following discussion regards the marital status among diabetics as a fixed unchanged variable in relation to the continuous process of diabetes mellitus, and in view of the few words above omits consideration of the converse.

Fitzgerald, et al, (1961), demonstrated that the excess of women over male diabetics is confined to married women. Among unmarried women diabetes is actually less common than it is among men at all ages, the relative incidence being about 2 : 3. Mortality statistics indicate that the incidence is higher in married women than in single women, and this difference is not found in men (Metropolital Life Insurance Company, 1957). Only among married women is there a large difference between the sexes in regard to the frequency of diabetes (Mosenthal and Bolduan, 1933).

Among males there appears to be a higher mortality rate from diabetes among single than married men. Divorced males seem to have the highest mortality rate among males, whereas widows seem to have the highest rate among females. In females, mortality rates were higher among the married than the single (Table 33).

Table 33: Age adjusted* death rates per 100,000 from diabetes by sex and marital status, white persons, age 20-74, United States, 1949-1951

Marital status	Males	Females
Single	18.2	12.6
Married	13.4	22.4
Widowed	19.6	25.3
Divorced	22.8	21.2

* Adjusted on the basis of the age distribution of the total population residing in the United States on April 1, 1950.

Source: Metropolitan Life Insurance Company, Statistical Bulletin, Vol.38, p.5. February 1957.

Caution is needed to interpret data on marital status from mortality statistics, because data on mortality and population come from two different sources and the designation of "marital status" may differ. Widowed or divorced persons may report themselves as either married or single and unless the misstatements counterbalance, the comparisons of their death rates will be distorted. Moreover, because the age composition varies greatly according to marital status, and since the age curve of diabetes is characterised by a rapid increase with age, the comparison must be based on relatively small age divisions, although these may be subsequently combined with suitable weightings for the separate age divisions.

U.S. National Office of Vital Statistics analysed the mortality from diabetes mellitus for various age groups according to marital status, for the years 1949-1951 (Table 34).

Table 34: Death rates per 100,000 from diabetes mellitus by race, sex and age - United States, 1949-1951

Age	White Males				White Females			
	Single	Married	Widowed	Divorced	Single	Married	Widowed	Divorced
20-24 years	1.3	0.5			1.6	1.1		
25-34 "	4.9	1.3		6.5	3.9	1.5		3.5
35-44 "	9.6	2.8		12.6	4.7	2.5	4.2	4.2
45-54 "	17.5	8.9	19.7	19.6	9.4	11.5	16.1	10.5
55-59 "	30.0	22.6	31.1	33.2	20.9	38.1	43.5	33.5
60-64 "	45.9	38.8	52.7	53.8	32.2	74.7	81.2	65.0
65-69 "	63.8	60.8	78.9	84.6	47.3	111.6	120.7	86.9
70-74 "	85.6	95.6	108.4	124.4	71.9	162.1	163.2	170.8
75+ "	112.9	139.9	153.5	182.9	114.5	193.9	195.4	269.5

Source: U.S. National Office of Vital Statistics, Special Reports: Selected Studies, Vol. 39, No.7, May 8, 1956

Death rates for single men were consistently higher than for married men up to the age of 70 years; after that married men had comparatively higher rates. Higher rates among single men were most marked at ages under 45 years. Among widows and divorced males death rates were higher than among either the single or the married groups. Divorced men had higher rates than did the other marital groups at most ages.

Up to the age of 45 years, mortality rates among females according to marital status, were similar to those found in males. Above the age of 45 years, in sharp contrast to the situation among males, the death rates for married females were higher than those for the single. This disparity increased with age,and at ages between 60 and 74 years the rates for married women were almost double those for single women. Among widows, diabetes mortality was higher than that of married women, and after the age of 45 years was consistently and distinctly higher than the rates for single women. Among divorcees, at ages 45 to 69 years, the mortality was consistently lower than among either the married or the widowed, but higher than for single women. Above the age of 70 years, mortality rates among the divorced women were the highest in all marital groups.

The higher rates among single persons at the younger age groups may reflect the lower marriage rates among young diabetics, as compared with non-diabetics. The relatively lower mortality rates among married men compared to single men may be due to, for instance, the fact that single men who become diabetic during their working life less likely to seek and carry out treatment than married men. Or it may be related to the various socio-economic differences that exist between the two groups.

The difference in mortality that exists between the single and married women is significant in that at all ages above 45 years, married women have correspondingly higher rates than single women. Many factors are possibly responsible for these differences; of significance are those connected with the various endocrine factors related to repeated pregnancies and cessation of menstruation. Pregnancy in itself does not tend to produce diabetes, but it does bring about an increased demand of insulin as pregnancy advances, and that these requirements fall off rapidly after delivery (Howells, 1956). Mosenthal and Bolduan in 1933, commented on the injurious effect of pregnancy upon the carbohydrate tolerance. Later, Pyke (1956) and Murphy (1957), recognised that pregnancy imposes a strain on the mechanism responsible for the control of carbohydrate metabolism, and if repeated sufficiently often, may be regarded as diabetogenic. Hagen (1961), found that in normal pregnancy, the fasting blood sugar decreased, while the oral glucose tolerance test shifted in a diabetic direction and there was an increased incidence of glycosuria. These changes were most marked at seven months, at which stage the GTT was often in the abnormal range.

An incidence of 6.2 per cent abnormal GTT's was found in 752 unselected pregnancies (Wilkerson & O'Sullivan, 1963).

The great majority of women survive even repeated pregnancies without apparent diabetes, and the mechanism of this tendency towards diabetes is unknown. The importance of a family history of diabetes in this connection is generally accepted, as is a past history of unexplained intrauterine and neonatal death, repeated pre-eclamptic toxaemia and the bearing of large babies Conn & Fajans, 1961).

Munro, et al (1949), reported from Glasgow that the large excess of married women over men among their group of patients, was confined to multiparous rather than nulliparous women. They believed that the difference was: "related at least in part to previous child-bearing".

Pyke (1956) observed that among nulliparous married women the incidence of diabetes is the same as among single women, but with increasing degree of parity the incidence of diabetes increases. In women who have borne two children the incidence is about the same as that in men: in those who have borne four to five children it is twice as high. Compared with the incidence in nulliparae, Fitzgerald, et al, (1961), reported the relative incidence of diabetes in women who have borne three children is about two, and in those who have had six or more, it is about six. The increased incidence of diabetes among highly parous (six or more) women was striking.

In population surveys, the same correlation between diabetes and high parity was found among hitherto undiagnosed diabetics. In the Bedford survey, nearly three times as many newly discovered diabetic women as normal women had borne four or more children.

Although highly parous women have a chance of developing diabetes several times that of nulliparous women, they do not do so until they pass the child-bearing years. The effect of parity, if any, seems to be a delayed one since the excess of women diabetics occurs only in relatively late life, not at the time of child-bearing. Indeed, if the age of onset of diabetes in women is related to their degree of parity, the latter seems to be of little importance with causation of diabetes. The average age at diagnosis of women developing diabetes is over 60 years, regardless of degree of parity. Among highly parous women (six and over) in whom the association is striking, the average at diagnosis is 64 years (Fitzgerald, et al, 1961). This is due to the fact that higher parous women - diabetic and non-diabetic, are on average older than less parous women. Fitzgerald, et al, also observed that women who bear children early did not develop diabetes before those who bear them at a later age. This will suggest that the age of onset at least is not related to the degree of parity. Moreover, there has been a striking fall in fertility (Glass & Grebenick, 1954) since the end of the last century, but in spite of this there was no decrease in the incidence of diabetes among married females.

If, to the age and parity factors a third one is added, i.e. the family history of diabetes, then the effect of parity on a female with positive family history may be to "uncover" a genetic tendency to develop diabetes later in life. With high degrees of parity, the frequency of family history of diabetes decreases.

Table 35/

Table 35: Number of patients (per cent) with positive family history of diabetes (i.e. one or more relatives known by patients to be affected)*

Patients aged 45 - 49	
Men	23.9
Single women	36.4
Married women - all	32.5
Parity 0 - 1	37.5
2 - 3	36.9
4 - 5	28.0
6+	21.2

Source: Fitzgerald, M.G. Malins, J.M., O'Sullivan, D.J. and Wall, Mary (1961): Sex, Parity and Diabetes. Quar. J. Med. N.S. 30, 57.

Table 35 is showing the effect of parity on diabetics with positive family history. The stronger the family history the less the degree of parity needed to produce clinical diabetes. But since the effect of parity is delayed, some of the factors must presumably be responsible for the frequent appearance of diabetes in the fifties and sixties. Obesity is one and menopause is another such factor.

It is difficult to say whether the increase of weight with parity is excessive in diabetic women, because there are no satisfactory figures for normal women with which they could be compared. However, it is reasonable to believe that single women at all age groups are more likely to keep their body weight under control than married women.

The time of occurrence of the menopause might explain the sharp rise in the incidence of diabetes in women from the age of 40 upwards. There is no direct evidence on this, but Joslin has commented on the possible role of menopause as an important factor which tends to increase the incidence of diabetes mellitus between the ages of 40-50 years. Although in established diabetics no consistent alteration in diabetes is noticed at the time of menopause, e.g. no increase in insulin requirement, the changes in endocrine functions during menopause might "trigger" the diabetes leading to its clinical appearance, and this could explain the long delay between the time of child-bearing and that of the appearance of overt diabetes.

The marital status among the 775 diabetics in our present study is shown in Table 36.

Table 36: Marital status of 775 patients first seen in 1969-71

Marital Status	Males		Females		Both Sexes	
	Number	% of known	Number	% of known	Number	% of known
Married	220	67.3	198	49.3	418	57.3
Single	67	20.5	82	20.4	149	20.4
Widowed	39	11.9	121	30.1	160	22.0
Divorced	1	0.3	1	0.3	2	0.3
Unknown	23		23		46	
Total	350		425		775	

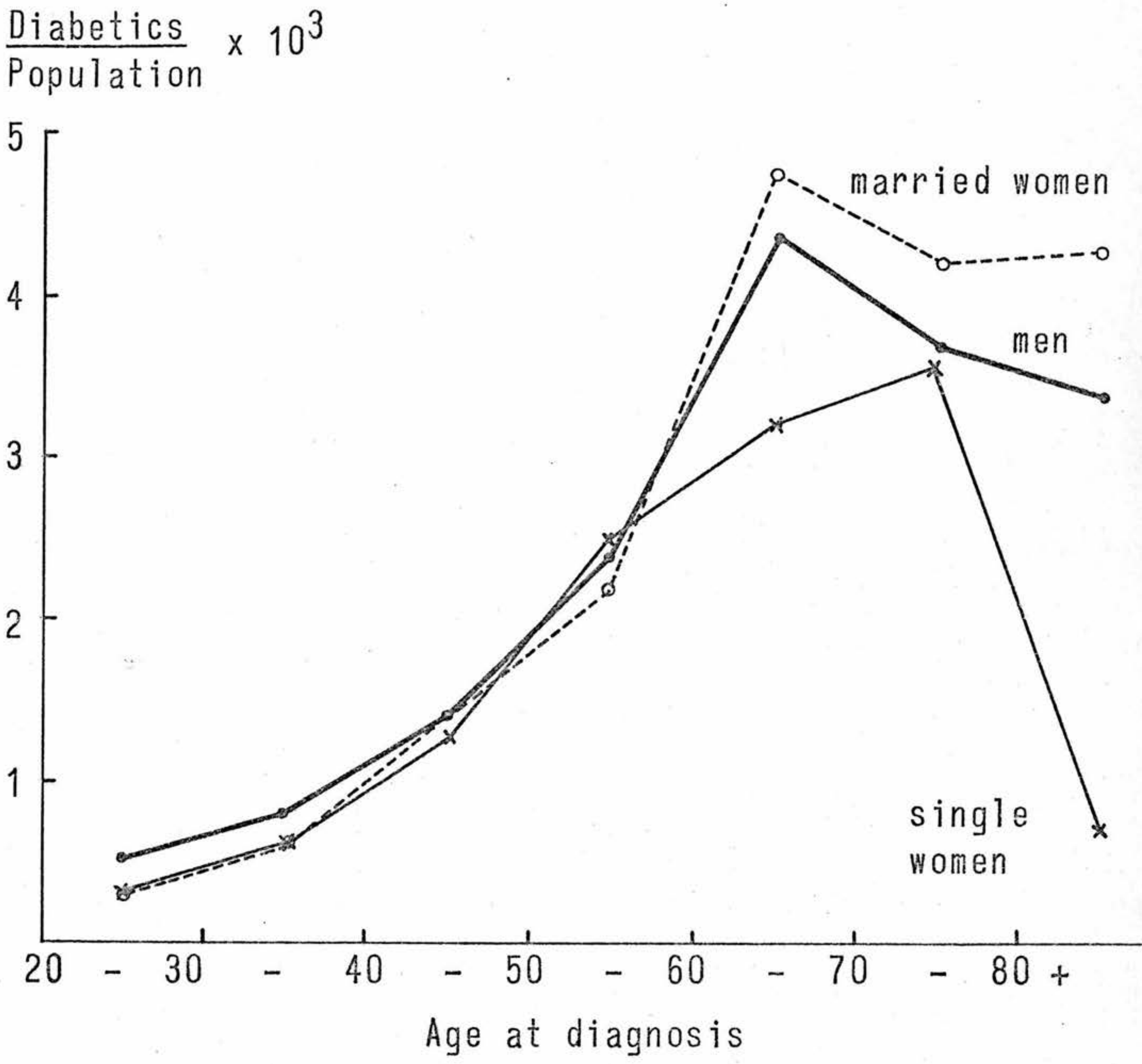
The marital status which is recorded, was that at time of diagnosis. However, the information about the marital status as well as about that concerning the occupation of patients was added to, for the majority of patients, during the whole period of the study, because, as will be discussed later, for a fairly large proportion of patients this information was not available from the clinic's records. The information regarding marital status was satisfactorily completed for 94 per cent of patients. This was done by utilising information collected from 294 patients interviewed; studying the 96 Death Certificates of those who died; consulting the master index in the Central Medical Records Department of the Royal Infirmary, and using the opportunity of seeing some patients personally when attending for their scheduled appointments.

In those with known marital status, 57 per cent were married, and 20 per cent were single. More males than females were married. About a third of females were widowed, while only 11.9 per cent of males were widowers. The proportion of single persons was the same in both sexes. The majority of married males and females were in the age group 60-69 (Table 13 in Appendix). 42 out of the 67 single males were below 30 years of age. However, only 25 out of the 82 single females were in the same age group; out of the remaining 57 patients, 50 single females were over 50 years of age.

An analysis of the marital status of all individuals in Edinburgh (Census, Scotland, 1971) shows that 49.3 of all males and 43.7 of all females were married, whereas 46.7 per cent of all males and 42.6 per cent of all females were single. This showed that the proportion of married to single females is

Figure 11.

Diabetes: relative incidence in men, single women, and married women.



General population figures from:

1971 Census Scotland, County Report, Edinburgh City. Table 8, page 6. Population by sex, age, and marital condition.

appreciably higher among diabetics than in the normal population.

Relating the number of married and single diabetics to that of the general population, Figure 11 shows the effect of the marital status in the general population on that of diabetics. In spite of the fact that married female diabetics were proportionally less than married male diabetics, the incidence of diabetes among married women is higher than among men (married and single combined).

Figure 11 also shows that at the early ages there is no noticeable difference between the incidence among men, married and single women. Above 50 years of age married women have higher rates than those for single women and men. Above the age of 70 years, the rates decrease sharply for single women but only slightly for men. It remains high among married women.

Socio-economic status and occupation of diabetics

The little available data on the influence of occupational and socio-economic status on the incidence of diabetes comes from mortality statistics. The analysis of mortality in relation to socio-economic and occupational position is probably not very reliable due to various errors that are commonly introduced in the process of collection and tabulation of the data. This is compounded in the case of diabetes by the fact that most of the deaths due to diabetes occur beyond the age span of 20 to 64 years, which is commonly used for mortality analysis according to occupation. Apparently a considerable amount of bias in the method of assessment would be introduced. The fact that diabetes is commoner among persons of late-middle and old ages means that one would be left to deal with only a minority of all deaths from diabetes during the period of active working life. This is particularly so in the higher socio-economic groups, where people generally retire from active work only at quite an advanced age.

Errors encountered during the process of collection and tabulation of the data comes from the fact that the occupational data, the basis for socio-economic classification, are taken from death certificates or census records, and that the information on the death certificate is based upon the usual occupation, while that on the census calls for the current or, in the case of the disabled or retired, the last occupation. The stated occupation on the death certificate is often erroneous or incomplete. Men change occupations because of health or other reasons after spending most of their years in one type of work, and, consequently, figures on occupational mortality do not always measure the extra risk in a particular occupation. Moreover, the increased mechanisation in all fields of work has tended to obscure the relationship of mortality to occupation, and that the mortality for a particular occupation or industrial group is affected as much, if not more, by social and other factors as by the work itself.

Data from the Registrar General for Scotland on the occupational mortality in five years (1959-1963) centred on the census carried out in 1961, shows the standard mortality ratio for the five social classes (Table 37).

Table 37: Males, single females, married females, standardised mortality ratio by social class, 20-64 years and over, diabetes mellitus, Scotland, 1959-1963

Social class		Males	Single females	Married females*
I	professional, managerial, etc.	120	-	39
II	intermediate occupation	119	62	61
III	skilled	96	116	86
IV	partly skilled	93	160	144
V	unskilled	110	173	165

*Classified according to husband's socio-economic status.

Source: The Registrar General's Second Supplement, Scotland, 1968, No. 114, Occupation Mortality, Table 6, page 103.

In Table 37, the standard mortality ratio is the number of observed deaths from diabetes in each classification, expressed as a percentage of the number of expected deaths on the basis of the age specific mortality for the sex from the disease in the general population, and this has been calculated for each of the three groups of individuals: men, married women and single women, in each of the five social classes.

It will be evident that the mortality ratios for diabetes among men were high at the extremes of the socio-economic scale, with the highest level in Social Class I (professional, managerial, and other occupations of comparable socio-economic level). The ratio for Social Class V (primarily unskilled workers) was only moderately elevated and not much higher than that for Social Class III (men in skilled occupations), and it was lower than that for Social Class II (occupations intermediate between class I and class III). The lowest ratio was found in Social Class IV (factory operatives and workers in occupations of comparable socio-economic level). For married as well as for single women the situation was almost completely reversed. The mortality ratios rose as the socio-economic status fell.

The English Registrar General reported similar trends in the standardised mortality ratio for diabetes according to the five social classes in the five years, 1949 to 1951. For men, the relation between socio-economic status and diabetes mellitus mortality however, disagreed sharply in some respect from two earlier reports of the Registrar General for England and Wales. The two earlier reports covering the period 1921 to 1923 and 1930 to 1932, shows that the mortality ratios for men in social classes I and II were significantly above the general average, those in social class II being the higher; the ratios in the remaining social classes declined with decrease in socio-economic level (Registrar General's Decennial Supplement, England and Wales, 1931a). The Registrar General for England and Wales' report of the three year period, 1959-61, again shows a variation in male mortality according to social classes, for the ages between 15-64. The highest mortality ratio was among those of social class V, and the lowest among those of social class I.

Although these reports are not exactly comparable, due to different age groups involved, and to the fact that allocation of occupation to the five social classes have varied from census to census, it perhaps illustrates the effect of the factors, explained earlier, which might render the occupational mortality data difficult to interpret.

There is as yet no strong evidence of any direct connection between occupation and diabetes mellitus. An indirect connection may exist since prosperity may be associated with an increase of obesity and hence of diabetes, and with more frequent consultation of the doctor, and therefore more efficient diagnosis. the only association between diabetes mortality and occupation recorded is in the food industry where deaths have been consistently higher than other occupations independently of social class involved (Registrar General, England and Wales, 1931b).

For the purpose of the present study, patients are divided into the five social classes (Classification of Occupation, Office of Population Censuses and Survey, 1970), (See Appendix C).

The latest data on social class distribution in the general population of Scotland comes from census, 1961 (Census 1961, Scotland, Vol. 6, Part 1, Occupational Tables). Figures for men of the general population were compared with those of the present study (Table 38). (Table 14 in Appendix shows the distribution according to age and sex). However, population is not sufficiently comparable for us to calculate rates.

Table 38:/

Table 38: Distribution of 775 patients according to social class, compared with social class distribution of men, Scotland, 1961

Social Class	Male Diabetics		General Population males Census,1961* per cent		Female diabetics	
	Number	Per cent known			Number	Per cent kn.
I	19	6.7	3.7		10	3.3
II	44	15.6	11.6		59	19.2
III	160	56.7	52.0		150	48.9
IV	46	16.3	23.0		55	17.9
V	13	4.6	9.8		33	10.7
Total known	282	99.9	100.1		307	100.0
unclass-ified & unknown	68	-	-		118	-
Total number	350	-	480,49		425	-

* Socio-economic group and social class, economically active and retired men. 10 per cent sample, Census, 1961, Scotland, Vol. 6, Part 1, Occupation Tables. Table 27, p.155 East Central Division. H.M.S.O. 1966.

Diabetic men were proportionally more in the first three of the five social classes compared to those of the general population. The situation is reversed in the case of the last two social classes.

The social class was not determined for 68 (19.4 per cent) males and 118 (27.8 per cent) females. This was due to unknown or uncertain occupation. The social class distribution was similar in both sexes. The majority of patients for whom social class was determined belonged to social class III. This is to be expected as social class III is presumably the largest social

Table 39: Distribution of 775 patients according to occupation and social class

ocial lass	Occupation								
	Manual	Non-Manual	House-wife	Student	Un-employed	Retired	Other economic-ally inactive	Not known	Total
					MALES				
	-	12	-	-	1	6	-	-	19
	1	34	-	-	1	8	-	-	44
I	72	39	-	-	2	47	-	-	160
	18	5	-	-	3	20	-	-	46
	8	-	-	-	2	3	-	-	13
known unclass-ied	-	-	-	25	3	21	2	17	68
tal	99	90	-	25	12	105	2	17	350
					FEMALES				
	-	2	8	-	-	-	-	-	10
	-	16	24	-	2	17	-	-	59
	10	33	92	-	-	15	-	-	150
	3	10	37	-	2	3	-	-	55
	17	-	13	-	-	3	-	-	33
known unclass-ied	-	-	40	15	-	3	4	56	118
tal	30	61	214	15	4	41	4	56	425

group found in Great Britain. The second largest category for males was social class IV, followed by social class II. In the case of females, there were more patients in social class II than in social class IV. Only 19 (6.7 per cent) of males, and 10 (3.3 per cent) of female diabetics belonged to social class I. Differences between the two sexes is also noted when social class V is considered; 10.7 per cent of females, and only 3.7 per cent of males belonged to that social class.

The classification of patients into the five social classes was according to their occupation, using the allocation of occupations and employment status groups of the classification of occupation (1970). Married women were classified according to their husband's occupations. Unemployed and retired persons were classified according to their last occupation if that was known. Because of their small number, those who were "permanently sick or disabled" and "other persons economically inactive", were grouped together and appear as "other economically inactive" in our study (see Appendix C). For the six patients in this category, the social class was unknown. Table 39 gives the association between occupation and social class classification for the 775 patients studied.

The failure to allocate social class in 186 patients is due either to unknown or to incompletely described occupation, or to failure in classification. For example, in the case of 40 females the social class was not allocated because they were described as "housewife", without any reference to their husband's occupation.

The majority of manual workers were of social class III, and there were none in social class I. For non-manual occupations the majority also belonged to social class III, but in their case no patient was in social class V. Among the retired, about half of the males belonged to social class III, next came social class IV; while in the case of retired females the majority belonged to social classes II and III, those belonging to social class II being more.

There were more unemployed males (12) than females(4). They were out of employment at the time of onset of the disease. 9 out of the 12 males and all 4 females were in the age group 40-59 years (Table 15 in the Appendix). There is a tendency among a few diabetics who are newly diagnosed, to change their occupation from that of a highly skilled, e.g. bus or crane driver, to a less skilled job, or else from a manual, e.g. steel erector, to non-manual employment within his own employment group.

It is believed that the "disability" caused by diabetes mellitus forces such individuals to take employment which does not involve extremes of physical exertion or long and variable hours of work. The number of such diabetics, however, is small, and comparing the economic position of diabetics for whom the occupation was known, with that of the general population (Table 40), shows that those out of employment were proportionally less than those found in the general population.

Table 40/

Table 40: Classification by economic position for 702 diabetics compared with that of the general population (per cent)

Economic position	Diabetics	General population* 15 years and over
	MALES	
Economically Active	60.3	78.4
In employment	56.7	72.4
Out of employment	3.6	6.0
Economically Inactive	39.6	21.6
Retired	31.5	11.1
Student	7.5	8.6
Other economically inactive	0.6	1.9
	FEMALES	
Economically active	25.7	45.4
In employment	24.6	43.5
Out of employment	1.1	1.9
Economically Inactive	74.3	54.6
Retired and Others+	69.1	47.4
Student	4.1	6.1
Other economically inactive	1.1	1.1

* Census, Scotland, 1971, County Report, Edinburgh City, Table 18, page 36, Edinburgh, H.M.S.O. 1973

+Including "Housewife".

Data on known economic position for 702 diabetics are compared with that on the general population of the City of

Edinburgh, derived from 1971 Census. Economic position was classified according to: economically active; and economically inactive (Appendix C). Economically active diabetics are shown, in both sexes, to be less than those of the general population. Diabetics who were economically inactive were more than the economically inactive group of the general population. The economically inactive diabetics consist mostly of retired men and retired or "housewife" women. This suggests that the problem associated with occupation and socio-economic status of diabetice is one consisting largely of old persons who had already reached the age of retirement, among whom the women were occupied only by housekeeping duties. Thus the problem, which will be discussed later in relation to economic disruption caused by diabetes, refers only to a minority of economically active individuals.

Out of 249 (216 newly diagnosed, and 33 with "Duration") patients interviewed, there were 93 employed persons (79 newly diagnosed and 14 with "Duration"). Data regarding the interview patients will be discussed in Part IV, but for the purpose of the present discussion, Table 16 in Appendix shows the number of patients who changed their jobs, had difficulty in obtaining a job, or were unemployed.

9 patients out of the 93 employed persons changed their job after the discovery of diabetes. Diabetes was the cause of such change in three patients, while in the other six it was because of other causes. All three patients who changed

their job because of diabetes were insulin-dependent. The two men were manual workers (taxi driver and steel erector). The lady who was an air-stewardess changed to a secretarial post.

All three patients reported that they had difficulty getting a new job, while none of the six patients who changed their jobs because of other reasons had such difficulty. Moreover, none of the other 84 employed persons had difficulty in continuing in their previous jobs.

Eleven patients (9 newly diagnosed and 2 with "Duration"), were economically active, but were out of employment during one year of their first attendance at the clinic. Only one patient out of the 11, was able to work because of diabetes. He was a man of 46 years, who developed diabetic retinopathy, nephropathy, and neuropathy within one year of the discovery of diabetes. Indeed, he had signs of diabetes retinopathy and sixth cranial nerve paralysis at time of discovery of diabetes.

The other 10 (6 men and 4 women) were unemployed because of other reasons. Among women these were associated with family commitments, while among men they were mostly diseases and disabilities other than diabetes. However, diabetes is thought to be a factor in their unemployment.

It has been stated that many diabetics have difficulty in obtaining employment due to some reluctance on the part of the employers to take known diabetics into permanent situations, although this problem does not arise in the case of those seeking temporary employment (Tunbridge, 1953).

The United States National Health Survey Interview Data for 1959-61, indicated that 37 per cent of the 1,700,000 known diabetics were actively at work; of the remainder, 16 per cent were retired, 38 per cent were female home makers, and 9 per cent fell into the category of "other", which included children, the unemployed, and the disabled. Data from a later survey in 1963-65, gives the proportion of employed diabetics by age and sex. In both sexes, 38 per cent over the age of 17 were employed. Among males, nearly 60 per cent at age 17 and over were working. The proportion was much higher at ages 17 to 44. There was a slight decrease in proportion at ages 45 to 64, and over one-fifth of the males at ages 65 and over were employed. There were fewer females at work than males. For ages 17 and over the proportion of females who were employed was about 23 per cent, or less than half of that of males. For females the pattern by age was the same as that for males; the proportion at work was greatest at ages 17 to 44; there was a slight drop at ages 45 to 64, and a sharp decrease at ages 65 and over.

Brandaleone and Friedman (1953), from the U.S.A., found that about 68 per cent of the companies investigated by them, employed known diabetics. A survey done in 1957 by a committee of the American Diabetic Association, indicated that among companies polled, 67 per cent of the small and 71 per cent of the large ones employed known diabetics. Several other studies evaluating the performance of the diabetic in industry have yielded reasonably satisfactory findings. Pell and D'Alonzo

(1960a & b, 1967a, 1968) have analysed the experience with diabetics in a wide variety of jobs at Dupont Company in Delaware, U.S.A.

In their report of 1967a, they emphasised the fact that 72 per cent of the diabetics in their series had either no absences or only one absence during the course of the year, and that only 6 per cent had more than three bouts of illness. This indicated that excessive absenteeism due to sickness in diabetics, as well as in non-diabetics, involved a small minority of individuals and that the assessment of the risk incurred in employing a diabetic must be made on an individual basis. In their report of 1968, they stressed the fact that the question of what policy to adopt regarding the employment of diabetics is to a large extent an academic one, because the onset of the disease in most cases occurs after the age of 40 years, when people are less likely than younger ones to look for new jobs. In their series of 662 cases, 623 (94 per cent) subjects developed diabetes after they were employed. They also reported that the majority of their patients were still active employees after ten years of follow-up, or have worked to the mandatory retirement age of 65. They concluded that a substantial portion of diabetics present no problem with regard to early disability.

These studies, and many others (Nasr, Block & Magnuson, 1966; Wyshak, et al, 1961) indicate that for the overwhelming majority of employed diabetics the quality of performance is high and that the record of absenteeism is favourable. They also have demonstrated that the diabetics are capable of functioning well in high managerial positions, as well as in positions requiring manual labour.

It was shown from the Proceedings of the Fifth Congress of the International Diabetes Federation held in Toronto in July 1964, that the problem of unemployed diabetics existed on a world-wide scale. It was emphasised that the problem was a serious one, not only for the individual diabetic, but also for the entire community. It was recognised in that congress that the solution to the problems of work for the diabetic, depends to a large extent on the education of the employers.

The Expert Committee on Diabetes of the World Health Organisation, reported in 1965 the following regarding the employment of diabetics: "The Committee viewed with dismay the restrictions in many countries hindering the employment of diabetics. All too often these restrictions are purely negative and are based on prejudice or ill-informed opinion about the effect of diabetes on a person's working ability or capacity. This injustice is perpetuated and even increased by the tendency to regard all diabetics as a group of patients with identical characteristics. This is bound up with the mistake of failing to distinguish between mild cases and cases under proper medical control on the one hand, and unco-operative, uncontrolled cases on the other. The Committee urged strongly that a much more liberal attitude be adopted which would aim at eliminating the discrimination against diabetics that has arisen simply on diagnostic grounds. Emphasis should be placed on the individual's aptitudes, experience, education, attainments and physical condition and not on his being diabetic. In short, a diabetic should have the same chances as any other person of obtaining and performing work for which he is medically and vocationally suitable."

Diabetics controlled by diet or hypoglycaemic drugs experience little difficulty in obtaining suitable work, while for those taking insulin, the working capacity, both in terms of efficiency and reliability, is indirectly related to the degree of control of their diabetes. As far as employment is concerned, the basis of good control is regularity of insulin injections, meals, exercise and supervision. The most suitable occupations are those in which such regularity is conveniently attainable. Occupations in which a reasonable degree of regularity in these respects is difficult to achieve, present problems in the maintenance of diabetic control which, although soluble by the intelligent and conscientious, may be beyond the capacity of other diabetics. In assessing the suitability or otherwise of any job it is therefore important to consider not only the type of work, but also the patient's ability and adaptability in respect of the management of his diabetes. Attacks of hypoglycaemia constitute the chief danger in the employment of diabetics. The possibility of sudden attacks of impairment of judgement, vision or consciousness, clearly makes certain occupations hazardous, not only to the diabetic, but to other people.

Diabetes complications in the newly diagnosed diabetics

With the discovery of insulin in 1922 and its general availability after that date, the prevention and successful treatment of diabetic ketoacidosis and coma became possible. As a result of this, and the lower mortality from infections, the life expectancy of the diabetic patients has increased steadily, particularly in those with onset of diabetes before the age of twenty years. With increased duration of diabetes comes a high frequency of cardiovascular-renal disease as a cause of death. Such vascular diseases affect both large and small vessels. The cause, prevention and treatment of these complications, including retinopathy, present the major problem and challenge in diabetes today. The effect of duration of the disease, and good control of hyperglycaemia on the development of these complications have been discussed in Part 1.

The data of the present study describes diabetic complications and the presence of other diseases at time of diagnosis of diabetes and shortly after diagnosis, with an observation period of 1 to 4 years. The presence of complications were recorded as they were stated in the patients' clinical records.

Diabetic coma and pre-coma are now omnibus terms and were used in this study to include patients at any level of consciousness providing they were ill enough to necessitate emergency treatment with insulin and intravenous fluid and electrolytes.

In recent years the nature of the underlying metabolic abnormalities has been categorized more exactly, and diabetic coma as mentioned in our study, will include the following: hyperglycaemic keto-acidosis; hyperglycaemic lactic acidosis, with or without keto-acidosis; non-ketotic hyperglycaemia, with or without hypernatraemia. All these states overlap each other, the common factors to all being the hyperglycaemia and, nearly always, the plasma hyperosmolarity. The latter is determined primarily by sodium, chloride, urea and glucose concentrations. A rise in blood glucose of 100 mgm per 100 ml adds 5.5 mosmol per liter to plasma osmolarity, while a rise of just 6 mgm per 100 ml of urea adds another mosmol per liter; thus plasma osmolarity is generally raised above the normal level of 280-295 mosmol per liter, even though the sodium concentration is often lowered. The non-acidotic hyperglycaemic group with altered consciousness is usually as "hyperosmolar non-ketotic", even though the same clinical picture may occur without hyperosmolarity if hyperglycaemia is offset by sufficient hyponatraemia.

Hypoglycaemia attacks occur in many insulin-dependant patients due to: insulin overdose; omission of meal; and vigorous exercise. It may also occur in elderly diabetics due to overdose of an oral hypoglycaemic agent. This complication was not present and thus not recorded in any patient either at first attendance or at end of observation period. However, hypoglycaemia was responsible for a number of hospital admissions and it will appear under the category of "Diabetes Complication" when hospital admissions are dealt with.

Other types of coma affect diabetics, for example, cerebrovascular accidents. These comas were classified under the appropriate headings.

Proteinurea was taken as the indication of renal affection. Diabetes nephropathy may present itself in various combinations of glomerular lesions (the diffuse glomerulosclerosis and the nodular form called Kimmerstiel-Wilson lesion); arteriolar lesion; and pyelonephritis. Nephropathy was recorded as such only when it was proved by renal biopsy. Proteinurea as such was classified according to severity and duration*: intermittently mild, constantly mild to moderate and constantly severe.

Of the specific diabetic complications, retinopathy is one which was routinely looked for in all patients attending the diabetic department. Its presence in one or both eyes was recorded if one or more of the following components was present: microanaurysms and deep round haemorrhages; hard exudate; soft exudates; venous changes; primary new vessels formation; large haemorrhages as retinal, preretinal, subhyloid, and vitreous

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* Test with Labstix gives semi-quantitive measurement of protein present in urine in mgm per 100 ml; trace; "$\overset{+}{30}$" ; "$\overset{++}{100}$" ; "$\overset{+++}{300}$" ; "$\overset{++++}{\text{over } 1000}$" . (Normal urinary protein content per 24 hr.range from zero to 100 mgm.)

Intermittently mild proteinurea = occasionally trace or "+" .
Constantly mild/moderate = In more than 3 occasions "+" or "++".
Constantly severe = In more than 3 occasions "+++" or more.

haemorrhages; and fibrosis.

Cataract due to metabolic changes in juvenile diabetics is rare, and its presence in our patients is discussed later under the heading of diseases associated with diabetes mellitus.

The clinical diagnosis of intermittent claudication was usually made in the presence of clinical symptoms of pain with the aid of examining arterial pulsation in the lower extremities; skin colour, temperature, state of its nutrition and the presence or absence of sweating; the condition of hair and nails were assessed, and the association of any macroscopical tissue necrosis (gangrene) was looked for.

The assessment of diabetic neuropathy depended largely on symptoms volunteered by the patients and was not routinely looked for. Diabetic peripheral neuropathy, which is the commonest type of neuropathy, was assessed by the presence of any sensory changes, loss of propreoseptive and vibration senses and diminished ankle or knee jerks. Other types of neuropathy were also included and they are: "Acute neuritis" type which is characteristic by painful neuritis affecting mainly the lower extremities and usually seen in elderly patients at or following diagnosis. Diabetic mononeuropathies affect especially the third, sixth cranial nerves; and ulnar, radial and popliteal nerves; diabetic amyotrophy, which is seen in elderly mild diabetics, affects the lower extremities. Autonomic neuropathy in men might present itself as impotence which is well known for its difficult management.

Diabetic foot ulcer, represents by itself a spectrum of complications which may culminate in gangrene. The main aetiological fa tors being: ischaemia, which includes atherosclerosis and microangiopathy; neuropathy, which includes motor loss, sensory loss and autonomic loss; infection; and trauma.

Table 41: Diabetes complications in 765 patients at first attendance and at end of observation period (31.13.72)*

Diabetes complications	"No Duration"				"Duration			
	Males		Females		Males		Females	
	First Att.	End of obs.	First Att	End of obs.	First Att.	End of obs.	First Att.	End of obs
Coma and pre-coma	8	0	10	0	2	1	2	1
Foot ulcer	0	1	0	2	0	0	1	1
Retinopathy	6	18	7	24	8	8	10	11
Int.claud. (incl.gangrene)	3	5	6	9	3	3	3	3
Neuropathy	8	23	6	15	4	4	0	1
Nephropathy	2	3	0	1	2	2	1	1
No. of patients with complications	16	37	25	43	14	14	14	15
Per cent of total patients	5.5	12.6	6.8	11.7	27.5	27.5	26.9	28.9

* including complications present at time of death for those who died during the observation period.

Table 41 shows the complications in 765 patients (10 patients who defaulted were excluded). The presence of these complications at first attendance were compared with those present at end of the observation period, for both "No duration" and "Duration" groups of patients.

The effect of the time factor on the development of these complications is apparent, in that, among the "No duration" patients at time of diagnosis (first attendance), only 5.5 per cent of males and 6.8 per cent of females had complications, while at the end of observation period their number increased to 12.6 per cent among males and 11.7 per cent among females. Among the "Duration" group of patients there was no appreciable increase during the observation period. However, patients who had complications at the end of the period remained proportionally higher among the "Duration" patients than among the "No duration" group.

Apart from diabetic foot ulcer, all complications were represented in the "No duration" patients at time of diagnosis. Among these patients the complications were present in 16 out of 293 males and 25 out of 369 females: 9 of the males and 19 of the females were above the age of 60 years. (Table 17 in Appendix). At the end of the observation period (Table 18 in Appendix), 21 of the 37 males and 34 out of the 43 females, who had complications were above 60 years of age. The main increase was in those who developed retinopathy and neuropathy.

It has been shown by many workers that in non-ketotic type of diabetes, non-progressive hyperglycaemia may exist in an asymptomatic stage for years or decades, even in young people without clinical evidence of either diabetes or its complications. (Fajans, et al, 1969; Fajans, 1971). Hence the so-called mild diabetics, i.e.

those treated by diet alone, may show diabetic complications at time of diagnosis which usually marks the occurrence of metabolic decompensation rather than the onset of the disease. On the other hand, the symptomatic manifestations of diabetic complications do not occur in the ketosis-prone type of disease until ten to fifteen years after the occurrence of symptoms of decompensation which usually happens within a short time of the onset of the disease. Thus, hyperglycaemia usually precedes the onset of a diabetic complication by many years in both types of diabetic patients.

Our data suggest that diabetic complications were present at time of diagnosis or shortly after, in patients who develop diabetes after middle age (majority of diabetics). Among the newly diagnosed patients, after a period of 1-4 years from diagnosis, these complications were present in 14.5 per cent of women and 13.6 per cent of men above the age of 60 years. Below the age of 60, complications were present in 6.7 per cent and 11 per cent of women and men respectively.

Due to the better understanding of the patho-physiology and improved management of the diabetic coma, all 22 patients presented with this complication at their first attendance were successfully treated. However, of the 96 patients who died, 2 (1 male and 1 female) died with diabetic ketoacidosis. Both patients had diabetes for a duration of more than 10 years. The deaths occurred in hospital and ketoacidosis was recorded as the principal cause of death in the case of the woman (died aged 70), while in the case of the man (had diabetes for 41 years and died at the age of 81), ketoacidosis was mentioned as the underlying cause of death and broncho-pneumonia was mentioned as the leading cause of death. Mortality from coma in patients over 60 years of age is reported to be as high as 30-50 per cent (Dillon & Dyer, 1937; Greenway & Read, 1958; Fitzgerald, et al, 1961).

The prognosis of patients suffering from diabetic coma has improved greatly since the introduction of insulin. Two other major factors have contributed to the dramatic improvement in prognosis. These are the improved administration of intravenous fluids and electrolytes, and the development of antibiotics. The mortality for patients unconscious on admission to hospital improved from 35 per cent to 10 per cent on comparing 1923-1939 and 1940-1941 figures at the Joslin clinic. (Joslin, et al, 1959). Others reported similar findings (Dillon & Dyer, 1937; Skillman, et al, 1958; Bortz & Spoont, 1967). Early recognition of diabetic ketoacidosis by general practitioners, with consequent earlier admission to hospital, has in recent years been a major factor in lowering the proportion of patients admitted completely comatose to hospital, and hence the institution of an earlier treatment. Zieve and Hill (1953), affirmed that the important prognostic factors in patients with ketoacidosis are, age, mean blood pressure, presence of associated non-diabetic illness, and blood urea, with less important factors being the degree of unconsciousness and the duration of coma. Blood sugar and plasma bicarbonate were poor prognostic indicators. Of the precipitating factors reduction in insulin dosage was responsible for 28 per cent of cases reported by Nabarro (1965), and for 27 per cent of cases studied by Sheldon and Pyke (1968). Those due to infection constitute 36 per cent (Nabarro, 1965), and 28 per cent (Sheldon & Pyke, 1968). Other precipitating factors include: emotional factors, insulin resistance, major acute illnesses with tissue anoxia, and abnormal liver utilization of lactate; and iatrogenic causes, e.g. by giving medication such as glucocorticoids and thiazides diuretics.

No striking correlation exists between the incidence of coma and the duration of diabetes. In a proportional number of diabetics with coma, diabetes had not been recognised until the onset of acidosis. Loeb (1955), stated that 5 of 7 fatal cases had no diagnosis of diabetes prior to coma. In the series of 124 cases of Zieve and Hill, 17 per cent, and in the series reported by Harwood (1951), 15 patients out of 67 (23 per cent) had no diagnosis of diabetes prior to coma.

In the past seven years there have been numerous reports and reviews about the syndrome of hyperosmolar non-ketotic coma (e.g. Jackson, 1969; McCurdy, 1970). In the series reported by Pyke, (1969), this syndrome accounted for 11 per cent of admissions for diabetic coma. About two-thirds of those affected are old, previously undiagnosed diabetics, and the remainder are generally elderly insulin-independent diabetics, often poorly controlled for a long time. Treatment with athiazide diuretic (McCurdy, 1970; Gerick, et al, 1971), and taking of excessive sweetened drinks such as lucozade (Macaulay, 1971), or chronic infection may precipitate this complex condition.

The precise pathogenesis is unknoen, but a common factor is an intense relatively prolonged glucose osmatic diuresis, resulting in water and electrolyte depletion, with increasing extracellular hyperosmolality. Reduced blood volume leads to a diminished renal plasma flow and glomerular filtration with an exaggerated rise in blood glucose, aggravating further the hyperosmolality and causing severe intracellular dehydration. High mortalities of 40 to 50 per cent have been reported. The death may occur from the underlying disorder, such as infection, irreversible hypovolaemic shock or cardiac arrest due to hypokalaemia. Arterial and venous thrombosis are commonly associated, sometimes proving fatal (Whelton, et al, 1971).

Some other patients on the other hand may have severe ketoacidaemia, although the blood glucose level is relatively normal (150 to 250 mgm per 100 ml.) This condition is most often seen in diabetics who, because of vomiting or inability to eat, have not retained sufficient carbohydrate, but have continued to take normal or increased amounts of insulin. They usually represent themselves as alert, have little or no thirst or polyurea, and are not dehydrated or electrolyte depleted (Duncan, 1971).

Hypokalaemia resulting in cardiac arrhythmias and muscle paralysis is one of the main causes of death in otherwise uncomplicated cases during the early hours of treatment. Occasionally,and especially in younger patients under 16 years of age, fatal cerebral oedema has developed rapidly and unexpectedly six to twelve hours or more after starting treatment (Fitzgerald, O'Sullivan and Malins, 1961; Warren, et al, 1969).

There is ample evidence that mortality from diabetic coma now is much lower compared to that of the 1930s and 1940s, when few truly comatose patients survived: 6 per cent (Pease & Cook, 1951) and 58 per cent (Joslin, et al, 1959). Among all Joslin clinic patients, for the years 1956-1966 (Bradley, 1971), the mortality due to diabetic coma was 1.1 per cent. Despite this low overall mortality among patients who had diabetic coma when first seen and treated by Joslin clinic physicians, the mortality rate of 3 to 5 per cent had persisted during the past 20 years. Others reported a persistent mortality of around 5-10 per cent of unselected cases of all ages coming into district hospitals (Fitzgerald, O'Sullivan & Malins, 1961; Beigelman, 1971; Alberti & Hockaday, 1972). Although these reports included deaths from causes other than uncontrolled diabetes, such as cardiac infarction, they do suggest that, in spite of the great achievement in understanding of the pathophysiology of diabetic coma and grasping the essential principles of treatment, the therapy and the management still needs to be improved. Despite increased knowledge of circulating hormones, electrolytes, and metabolic level and concentrations, the reasons for the persistent mortality from diabetic coma is still not understood.

Diabetic retinopathy accounts for approximately 14 per cent of newly registered blindness in the United Kingdom (British Diabetic Association Committee on Blindness, 1971). Newell, (1967), reported a similar estimate for the U.S.A. abnormalities of the fundi form the biggest group of diabetic complications. Retinopathy is found with greater frequency as the duration of diabetes increases. Whittington (1968), reported a prevalence of retinopathy of 6.4 per cent among newly diagnosed diabetics, while those with a duration of 26-30 years, the prevalence of retinopathy was 63 per cent. In children and adults, retinopathy at time of diagnosis was very rare. but in those aged over 60 years, it was found in 11 per cent.

In addition to those who are blind, there are many who have very poor vision because of retinopathy. Visual impairment may be due to intra-ocular bleeding from either distorted veins or new capillaries (neovascularization) and may be followed by irreversible fibrosis, retinal detachment and glaucoma. Geckert, et al (1967), found that at least 50 per cent of patients in whom neovascularization occurred in the peripheral retina became blind in both eyes within five years, and the same proportion within two years, when the new vessels were more central or came from the disc.

Duncan, et al (1968), shows that although neovascularization occurs most often in younger diabetics of long duration, its appearance in old insulin-independent diabetics is commoner than is supposed. In the latter age group, however, diabetic maculopathy with hard wax exudates, or oedema and less extensive bleeding leading to neurolan degeneration, is a more usual cause of visual impairment and much less related to the duration of diabetes. In our present study in the newly diagnosed diabetics, retinopathy at the end of the observation period was present in 8 per cent of those above the age of 60 years, but only in 4 per cent of those below 60 years. There seems to be little difference in the prevalence of retinopathy between the two sexes; it was slightly commoner in women but this is due to the fact that there were more women diabetics.

Although there are various techniques for the treatment of retinopathy, none will improve visual acuity or be effective especially if the retinal lesions are advanced. The current modalities of therapy for diabetic retinopathy include photocoagulation, pituitary ablation and a long-term daily oral treatment with clofibrate.

As in the case of retinopathy among the newly diagnosed patients, neuropathy was commoner in those above the age of 60 than in the younger age group.

The occurrence of diabetic neuropathy as the presenting complication in maturity-onset type of diabetes, and the occasional lack of relation between the duration of severity of the abnormal glucose metabolism to the presence of neuropathy, has been interpreted as indicating a lack of causal relationship between hyperglycaemia and neuropathy. Ellenberg (1963), reported that "complications" without manifest diabetes have occurred. Rudy (1945), suggested that peripheral neuropathy may be a concomitance abnormality, and increased blood sugar has been noted in patients with peripheral neurological manifestations (Bonkalo, 1950). However, now it is believed that hyperglycaemia usually preceded the onset of neuropathy by many years (Fajans, 1972; Greenbaum, 1964).

Greenbaum (1964), suggested that hyperglycaemia and glycosuria "should be regarded as related to neuropathy only in that they may be reversed by the same agents". No longer does neuropathy seem likely to be a manifestation of micro-angiopathy of the vasa nervorum (Greenbaum, 1964; Thomas & Lascelles, 1966). Instead, the basic pathological lesion, segmental demyelinization of nerve fibres, may be the consequence of a reversible interference with the metabolic activity of the schwann cells. Greenbaum furthermore, suggested that severe diabetic neuropathy is associated not only with demyelinization, but also with irreversible axonal degeneration of nerve fibres, a lesion which would not be expected to improve by correction of hyperglycaemia. Thus there appears to be a relationship between abnormalities in carbohydrate intermediary metabolism and the development of neuropathy. In the earliest stages of the disease, maintenance of normal blood glucose levels has the potential of preventing the occurrence of diabetic neuropathy.

"No duration" group of patients also showed an increase in those who developed intermittent claudication and diabetic foot ulcer over the observation period. The increase was mainly in those patients above the age of 60 years.

Diabetics, especially the more elderly, are particularly likely to have trouble with their feet in greater or lesser degree. It is known that "diabetic gangrene" not infrequently runs a somewhat benign course and is sometimes painless. The aetiological factors producing lesions on the feet of diabetics were described by Oakley, et al (1956), as septic, neuropathic, ischaemic, and combinations of these three. Pure examples of any one factor are rare and it is the addition of sepsis to a foot already disensitized by neuropathy and devitalized by ischaemia that accounts for the vast majority of cases of "diabetic gangrene".

The recorded increase over the observation period in those who proved to have nephropathy was very slight, and confirmation of the presence of this complication was difficult, and unless it was proved by a renal biopsy it was not recorded as such. However, the presence of proteinuria in diabetic patients, especially if repeated and of a considerable degree, gives an indication of renal involvement. The first clinical manifestation of diabetic nephropathy usually consists of a mild and intermittent proteinuria. It has been postulated that diabetics have subclinical proteinuria as an early indication of renal involvement. Panzram, et al (1967), compared the degree of "physiologic" proteinuria in 130 diabetic patients without obvious renal disease, and 140 non-diabetic controls. They reported a mean value of 3.3 mgm of protein excreted in the urine every four hours in the diabetics, and 1.7 mgm every four hours in the controls. Increased "physiologic"

Table 42: Distribution of Proteinuria in 775 patients

Proteinuria	"No Duration"				"Duration"			
	Males	%	Females	%	Males	%	Females	%
Constantly absent	265	88.6	336	90.1	43	84.3	50	96.2
Intermitt-ently mild	22	7.4	21	5.6	4	7.8	1	1.9
Constantly mild or moderate	10	3.3	9	2.4	3	5.9	1	1.9
Constantly severe	2	0.7	6	1.6	1	2.0	0	-
Unknown	0	-	1	0.3	0	-	0	-
Total	299	100.0	373	100.0	51	100.0	52	100.0

proteinuria was present in 38 per cent of the diabetics and in only 10 per cent of the controls. Keen and Chlouverakis (1963, 1964), reported their findings in diabetics without clinically demonstrable proteinuria. Using immunologic method for specific detection of albumin in the urine, they noted that diabetic patients excreted more albumin than did the non-diabetic controls. The "borderline" diabetic persons had intermediate levels of "albuminuria". Episodes of pyelonephritis and other infections, diabetic acidosis, and the like, accentuate the proteinuria, which, after a period of months or even years, becomes permanent and significant and the amount of protein may reach 5 to 10 gm per 24 hours. Oedema, hypoproteinuria and hypercholesterolemia complete the clinical picture of nephrotic syndrome, diabetic nephropathy being one of the frequent causes of nephrosis in adult patients.

Table 42 shows the distribution of proteinuria in patients included in our study. It was constantly present in 4 per cent of newly diagnosed males and females. Proteinuria was present more among males than females of the "Duration" group of patients. Among the newly diagnosed "No duration" patients, 20.8 per cent of males and 21.6 per cent of females below the age of 40 had proteinuria, while in the same group of patients proteinuria was present in only 10.0 per cent of males and 8.4 per cent of females above 40 years of age. (Table 19 in Appendix).

Knowles and Colleagues (1965) found permanent proteinuria in 33 per cent of 108 "juvenile" patients with diabetes of 15 or more years duration. In a random sample of 1000 consecutive urinalyses among ambulatory patients of the Joslin Clinic, proteinuria (50 mgm per 100 ml or more) was found in 51 specimens (5 per cent) (Balodimos, 1971).

Most studies reported no differences between the sexes regarding the incidence of nephropathy (Balodimos, 1971; Tateishi, 1965). The age at onset of diabetes on the other hand, has a direct bearing on the frequency of nephropathy. Most of the earlier cases of the nephrotic syndrome were found in older patients, hence it was thought that this was a complication of diabetes in later life. The relatively low frequency of onset of diabetes in persons before their twenties gives, in most series, a greater number of patients in the older age groups, and therefore, the clinical impression that nephropathy predominates in older diabetics. Balodimos has demonstrated from data of the Joslin clinic that the younger the age at onset of diabetes, the greater the frequency of nephropathy as a cause of death. While in the case of patients in whom the onset of diabetes took place after they were 40 years old, about 50 per cent died from coronary artery disease, and less than 5 per cent from nephropathy. White (1956) showed that 50 per cent of juvenile diabetic patients ultimately show renal involvement, and a larger number of these succumbing to this complication in the prime of life.

Entmacher, et al (1964), found that the relative mortality rates from renal vascular disease to be 17 times greater in diabetic patients than in the general population. In the experience of the Joslin clinic diabetic nephropathy was the cause of death in 5.7 per cent of 6800 patients who died between the years 1956 and 1964 (Balodimos, 1971). Other renal diseases accounted for an additional 3.3 per cent, so that renal disease was the cause of death in a total of 9 per cent. Cardiovascular disease on the other hand, was responsible for death in 68 per cent of all patients. Marble (1972) reported from Joslin clinic, the following figures for 5009 patients who died during 1960 to 1968; 8.9 per cent from renal diseases and 53.2 per cent from arteriosclerotic heart disease. Both Balodimos (1971) and Marble (1972) reported that for persons with an onset of diabetes under 20 years of age, diabetic nephropathy and other renal diseases accounted for almost one half of all deaths. Marks (1965), analysed the pattern of causes of the deaths, covering deaths occurring in 1956-1962, of Joslin clinic patients. He demonstrated that for persons with onset of diabetes under 20 years of age, and those with onset between the ages of 20 to 39, the percentages of deaths due to cardiac causes increased gradually with the duration of diabetes, i.e. under 10, 10 to 19, 20 to 29, and 30 years and over. Nephropathy as a cause of death had its peak for those who died after 10 to 19 years of diabetes, and declined in frequency thereafter. About half the deaths of the patients with onset under age 20, who had the disease 10 to 19 years, were due to nephropathy, while nephropathy was the cause of death in only one-fourth of those with duration of more than 30 years. Balodimos explained this observation by suggesting

Table 43 : Age standardised rate of complications according to "Established" type of treatment

Treatment	Proteinuria	Retinopathy	Inter.Claud.	Neuropathy	Diabetic foot ulcer	All complications
MALES						
All types of treatment	12.6	7.7	2.3	8.0	0.3	30.9
Insulin	32.1	24.7	0.4	0.80	0	66.2
Oral drugs	14.1	8.6	3.9	7.3	0.5	34.4
Diet alone	5.9	4.2	0.6	4.8	0	15.5
FEMALES						
All types of treatment	9.2	8.7	2.6	3.8	0.7	25.0
Insulin	9.1	9.2	3.8	8.1	0	30.2
Oral drugs	10.3	11.0	3.1	4.5	1.1	30.0
Diet alone	1.8	2.1	0.6	1.5	0	6.0

that among patients having the juvenile type of diabetes, those who escape significant glomerulosclerosis live long enough to be affected by generalised premature arteriosclerosis and its complications.

Tateishi (1965), reported from Japan that renal vascular disease was the cause of death in 17 per cent of 154 diabetics examined post mortem. Lundback (1965), found that uremia was the cause of death in 35 per cent of those in whom the onset of diabetes occurred before they were 40 years old, and in 12 per cent of those in whom the onset took place after they were 40 years of age.

Age standardized rate of diabetic complication developed during the observation period among the 775 patients as shown in Table 43. For all complications insulin-dependent patients had higher rates than those stabilized on oral drugs or diet alone. This is more clear in the case of males. Considering complications in patients of all types of treatments, of all complications, proteinuria was the most frequent in both males and females. This is followed in both sexes by retinopathy. Insulin-dependent men showed higher rates of proteinuria and retinopathy than those treated by oral drugs or diet alone. In the case of women the situation was different in that those treated by oral drugs showed the highest rates of proteinuria and retinopathy. Insulin-dependent females, and males treated by oral drugs shows higher rates of intermittent claudication and neuropathy. Only 4 patients had diabetic foot ulcer and all were stabilised on oral hypoglycaemicagents.

From Table 43 it is clear that the lowest complication rates were present in patients controlled on diet alone, while those who needed either insulin or oral hypoglycaemic drugs to regulate their blood sugar showed higher rates of complications. Insulin-dependant patients had the highest incidence of diabetes complication.

Various workers believe that conclusive answers to questions of whether "normalization" of blood glucose in preventing, ameliorating or postponing the micro-angiopathic, macro-angiopathic and neurological changes associated with diabetes, is unlikely to evolve until therapy is devised which will continuously achieve complete normalization of hormonal and metabolic abnormalities. However, it seems that those patients with insufficient endogenous insulin develop complications more than those who still have some degree of endogenous insulin secretion, regardless of duration of disease. Moreover, achievement of an ideal body weight by the reduction of calorie intake, followed more closely by those controlled on diet alone, may be associated with improvement or correction of fasting, hyperglycaemia and glucose intolerance, and a reduction of known risk factors for atherosclerotic vascular disease such as obesity, hypertension, hyperlipidemia and hyperglycaemia. When calories are restricted to facilitate moderate weight loss, while an adequate protein intake is provided, intake of both carbohydrate and fat will be restricted sufficiently so that further attention to their proportion would appear not to be critical. Epidemiological evidence indicates that fewest vascular complications are found when the habitual dietary intake results in leanness of body weight regardless of the proportion of carbohydrate or fat in the diet (Albrink & Davidson, 1971).

In conclusion, it was seen that diebetic complications are present at time of diagnosis more in patients who were over the age of 60 years than in those who were below 60 years. However, when the complications are standardized for age, it was seen that insulin-dependent patients had higher rates than those treated by oral hypoglycaemic drugs or diet alone. This was especially so among men. Proteinuria and retinopathy were the most frequent complication in both men and women observed in the short follow-up period of 1-4 years.

Cardiovascular Diseases in Diabetics

Atherosclerotic vascular diseases in the diabetics appear to be the same as that seen in the non-diabetic population. Current concepts of the pathogenesis of atherosclerosis obtained from data of epidemiological, clinical and experimental studies would assign multiple interrelated contributory (risk) factors rather than a single aetiological agent. Determining factors in the rate of atherogenesis include genetic influences, race, familial aggregation, age, sex, body weight, diet, blood pressure, cigarette smoking, serum lipids (familial and secondary hyper-lipoproteinaemia) hyperglycaemia, exercise and psycho-social tension. Epidemiological and prospective studies (Epstein, 1967; Keen, et al, 1968) have indicated that diabetes and hyperglycaemia are independent risk factors associated with the prevalence of cardiovascular diseases. Pell and D'Alonzo (1967b) have shown that this is true especially in the presence of hypertension. Increased activity of the polyol pathway has been linked with vascular diseases among diabetics. With increased insulin activity and hyperglycaemia, glucose is converted via the insulin-independent polyol pathway to sorbitol and frucose. Activation of the polyol pathway may be one pathogenic mechanism by which hyperglycaemia contributes to vascular degeneration (Clements, et al, 1969). Thus it is suggested (Fajans, 1972), that "normalization" of blood glucose may be one step by which accelerated atherogenesis could be inhibited.

There have been several reports of a high prevalence of established diabetes in patients suffering from cardiac infarction. Wahlberg (1963) reported a frequency as high as 18 per cent, although the more usual figure for the prevalence of diabetes in cardiac infarction patients was 8-10 per cent, figures for women generally being higher than for men. Pell and D'Alonzo (1965), Seivers, et al, (1961) and Wright, et al (1954), reported prevalence of diabetes among persons who had suffered a cardiac infarct as being 2-5 times greater than that found among control groups. Wahlberg (1962, 1966) found that abnormal carbohydrate tolerance, measured by intravenous test, was much commoner in patients known to have cardiac infarcts 3-8 weeke previously, than in control subjects without clinical or ECG evidence of coronary disease. Moreover, there was a connection between the results of the intravenous glucose tolerance test and length of subsequent survival. After about 4 years there was a significantly higher survival rate among the patients whose glucose tolerance tests had been normal (88 per cent), than amongst those whose tests had been borderline or abnormal (73 per cent). This suggests that abnormality or carbohydrate tolerance leads to an increased risk of acute cardiac infarction, or is a consequenceof it, and that after infarction the long-term prognosis is related to carbohydrate tolerance. Oral glucose tolerance testing in the acute phase of myocardial infarction often reveals mild elevation of peak and 2-hour blood sugar value (Sowton, 1962; Cohen & Shafrir, 1965).

Thirty patients tested within a day of the infarction showed a mean blood sugar level 2 hours after 50 gm glucose of 124 mgm per 100 ml, against a value in control subjects of about 80 mgm per 100 ml. On retesting six months later, glucose tolerance had returned to approximately normal figures.

Many investigators have found that persons with the highest post-prandial blood glucose levels are at the greatest risk of developing overt coronary heart disease. In the whole population study of 1946, in Oxford, Massachusetts, after exclusion of known diabetics, participants were grouped according to their post-prandial blood glucose levels. Seventeen years later (O'Sullivan, et al, 1968), the incidence of ECG changes indicative of myocardial ischaemia was twice as high in persons with blood glucose value of 170 mgm per 100 ml or more as in those with values below 140 mgm per 100 ml. This significant difference disappeared when those who had become overtly diabetics during the intervening years were excluded from the analysis. Persons with blood glucose values above the 92nd percentile after taking glucose by mouth showed a greater than expected incidence of ECG changes even after the exclusion of those who had become diabetic. Ostrander (1970) showed that persons who developed overt coronary heart disease had shown higher blood glucose values one hour after 100 gm glucose by mouth, than do those without subsequent clinical evidence of coronary heart disease. Knowing the fact, demonstrated by population surveys, that persons with the highest post-prandial blood glucose values are the most likely to become overtly diabetic. These and similar data are compatible with the concept that diabetes accelerates the development of coronary heart disease, but do not imply that all patients with coronary heart disease are diabetics, however mild. However, there is little evidence, based on clinical data, of an increased prevalence of coronary disease in diabetics compared with non-diabetics. Pyke (1968c) studied coronary disease among diabetics attending the diabetic clinic at King's College Hospital, aged 40-49 and 50-59 years, and compared it with those present among the post office transport workers of the same age groups, previously studied by Reid, et al, (1966). Pyke found no greater prevalence of coronary diseases among diabetics. Others reported the same findings (Patharia & Sacher, 1961), while Seivers,(1964), and Lewis and Symons (1958) found that coronary diseases were commoner in diabetics. Results from such studies have been criticised because they have not been compared with satisfactory control groups. In the majority of them, when a comparison between diabetics and non-diabetics has been made, the figures for the non-diabetics have been taken from previously published series. This is not satisfactory since criteria of diagnosis, methods and thoroughness of examinations and characteristics of population may vary. There is as yet no conclusive answer to the question of there being any causal cpnnection between diabetes and coronary disease.

Coronary artery disease is predominantly an affliction of older people. So is diabetes. There will therefore be a relatively higher prevalence of coronary disease among diabetics,

Table 44: Heart Diseases among 765 patients at time of first attendance and at end of observation period*

Diseases	"NO DURATION"				"DURATION"			
	MALES		FEMALES		MALES		FEMALES	
	First Attendance	End of Period	First Attendance	End of Period	First Attendance	End of Period	First Attendance	End of Period
Rh.Heart Disease	1	1	12	13	0	0	1	1
Acute Myo. Infarction	7	19	6	10	1	3	0	1
Other Isch.Heart Dis.	42	49	44	54	5	8	6	6
Cong. Card. failure	14	15	37	38	4	4	5	5
Left Vent. failure	4	4	8	7	0	0	1	1
Other Sympt.H.D.	1	3	6	7	1	0	0	0
Other forms of Heart Dis.	0	0	3	3	0	0	0	0
Number of patients with heart disease	55	71	86	94	8	11	11	11
Per cent of total patients	18.8	24.2	23.3	25.5	15.7	21.6	21.2	21.2

* includes conditions present in Dead at time of death

and vice versa. In our study, among the "No duration", 30 out of 42 men and 38 out of 44 women who had ischaemic heart disease at first attendance were above the age of 60 years (Table 20 in Appendix). At the time of first attendance there was no diabetic patient below the age of 40 years, either in the "Duration" or in the "No duration" group, who had myocardial infarction or "other" ischaemic heart disease. At the end of the observation period only one man from the "Duration" group, aged 38, had developed ischaemic heart changes (Table 21 in Appendix).

Table 44 shows the variety of heart diseases in both groups of diabetics at their first attendance compared with those developed during the observation period. These diseases were grouped according to the International Classification of Diseases, Eighth Revision (Table 20 in Appendix).

Of the 141 (55 males and 86 females) who had heart disease at time of diagnosis "No duration", 89.1 per cent of males and 58.1 per cent of females had ischaemic heart disease. Similar proportions were present among patients of the "Duration" group. Ischaemic heart diseases increased in both groups of patients during the period of observation, and among the "No duration" patients this constituted 95.8 per cent of males and 68.1 per cent of females who had heart disease at the end of the observation period. Among all 662 patients with "No duration" (293 males and 369 females), myocardial infarction presented itself at time of diagnosis in 2.4 per cent of males and 1.6 per cent of females. "Other" ischaemic heart disease classified according to I.C.D. Eighth Revision, includes: 411 - other acute and subacute forms of ischaemic heart disease; 412 - chronic ischaemic heart disease; 413 - angina pectoris; 414 - asymptomatic ischaemic heart disease. "Other" ischaemic heart diseases were present in 14.3 per cent of males and 11.9 per cent of females. These figures increased during the observation period, and ischaemic heart disease was present at the end of observation period in 16.7 per cent of males and 14.6 per cent of females. The corresponding numbers of acute myocardial infarction were 6.5 per cent and 2.7 per cent for males and females respectively. The majority of increase occurred in those of old age groups. There was proportionally less obvious increase of ischaemic heart disease during the observation period for the "Duration" group, especially in the case of females of this group among whom no increase was noticed.

The percentage of patients who had any form of heart disease shows a noticeable increase over the period of observation in the case of males (from 18.8 per cent to 24.2 per cent among the "No duration" group, and 15.7 per cent to 21.6 per cent among the "Duration" group), but only slight increase in case of females of "No duration" group, and none among females of the "Duration" group. However, among the "No duration" patients 25.5 per cent of females ended with heart disease compared with 24.2 per cent of males. This was due to the fact that in spite of more males than females having developed ischaemic heart disease during the period of observation, other forms of heart disease were present at the time of diagnosis among females in much higher proportion than among males. Rheumatic heart disease and congestive heart failure were present more among females than among males at time of discovery of diabetes. Patients with these disorders showed only a slight increase during the observation period.

Age seems to be the principal factor to influence the incidence of coronary heart disease in diabetics as it is in non-diabetics. In contrast to the statement, which is widely accepted by clinicians, that diabetes is an important cause of coronary disease in young people, our study, like many others (Liebow, et al, 1955; Bradley & Bryfogle, 1956; Patharia & Sacher, 1961) proved that there is a very low frequency of coronary disease in young diabetics, as is the case for non-diabetics. Hayward and Lucena (1965) studied the cause of death in 1350 diabetics taken from Birmingham Hospital clinic population of 6016, who were observed for 15 years. They found that of 17 women who had died under the age of 40 only one had died from coronary artery disease (no separate figures for men were given).

In non-diabetics, coronary artery disease is more common in men than in women at all ages, both in clinical practice and in epidemiological studies, especially in earlier life (Dawber, et al, 1962; Mosbech & Dreyer, 1966). Under the age of 50 coronary disease is five times as common in men than in women, but this is not the case with diabetics. Our material about the newly diagnosed diabetics (Table 45) shows that ischaemic heart disease was not seen in diabetics below the age of 40. "Other"ischaemic heart disease and acute myocardial infarction in the age group 40-59 were only twice as common in males than in females, both at time of diagnosis and at end of observation period. For patients above the age of 60, ischaemic heart disease apart from acute infarction, was nearly equally represented in both sexes. This was more noticeable at end of observation period. In the same age group the incidence of acute myocardial infarction was much higher among males than females (about three times as much in males as in females at the end of observation period).

Table 45: Ischaemic heart disease in 662 newly diagnosed diabetics at time of diagnosis and after 1-4 years, by sex and age group (per cent of total patients)

	Age 40-59 years*		Above 60 years	
	Acute myocard. infarct.	Other ischaem. heart dis.	Acute myocard. infarct.	Other ischaem. heart dis.
	AT TIME OF DIAGNOSIS			
Males	2.2	13.0	3.3	19.5
Females	1.0	6.1	2.1	16.2
	AFTER 1 - 4 YEARS			
Males	2.2	16.3	11.0	22.1
Females	1.0	7.1	3.9	20.1

* No cases recorded in diabetics below age of 40 years.

From King's College Hospital, material was studied by Pyke (1968c) which showed that the prevalence of known coronary disease in diabetics under the age of 50 years is equal in both sexes. In older diabetics the same sex incidence of coronary disease was seen. Women diabetics with coronary disease (9.2 per cent) slightly outnumber men (8.1 per cent) at the ages of 50-69 years. It was suggested that the findings of an equal sex incidence of coronary heart disease in diabetics indicates that in early life coronary disease is commoner in diabetic women than non-diabetics. Our data does not show an exactly equal sex incidence of coronary heart disease among diabetics. It does nevertheless indicate a lower male to female ratio in the incidence of ischaemic heart disease among diabetics compared with that of the general population. Armstrong, et al (1972), from Edinburgh, reported the incidence rate of acute heart disease as first manifestation of coronary heart disease among the general population. In their series the male to female ratio was 4.4 for those aged 20-49; 3.7 for those aged 50-59; and 2.7 for 60-69 age group. The overall annual incidence of episodes of acute heart attack in the population aged 40-69 years was 1.5 per cent for men and 0.5 per cent for women; for first attacks it was o.7 per cent for men and 0.2 per cent for women of 40-69 age group.

Newly diagnosed diabetics have a lower frequency of coronary disease than patients who are already known to have diabetes. Pyke studied the prevalence of coronary heart disease in patients aged 50-69 years in relation to the known duration of diabetes. The change of prevalence to a higher one is chiefly between newly diagnosed diabetics on the one hand and those who have had diabetes for only a short time (1-3 years) on the other. Subsequent increase in prevalence is only slight. Our data suggests that there is a great risk of developing ischaemic heart disease in the first few years after the discovery of diabetes. Long term duration seems to have little role in the development of ischaemic heart disease. Most newly diagnosed patients with ischaemic heart disease had these disorders at the time of discovery of diabetes, and the increase in the number of patients who developed such disorders during the 1-4 years of follow-up was more marked among the newly diagnosed than among those with a "Duration". The increase over the period of observation was slight among males and still less among females of the "Duration" group.

The observation that, among diabetics, there is a greater risk of developing ischaemic heart changes at or shortly after diagnosis, supports the idea that age of the patient is of more importance than the hyperglycaemia as a factor influencing the development of ischaemic heart disease.

Hypertension and Diseases of Peripheral Vascular System

There is as yet no conclusive evidence that the blood pressure of diabetics differs significantly from that of non-diabetics. The same applies to arterial diseases, where there is no evidence of a specific type of diabetic arterial disease. The clinical finding of ischaemia and gangrene in diabetics sseemed to be due to a greater tendency to arteriosclerosis in the arterial system below the knee, and a much greater frequency of peripheral neuropathy.

The problem of hypertension and diabetes was thoroughly reviewed by Freedman, et al (1958), who concluded that hypertension was only more common to a significant degree over the age of 70 years. Pickering (1955), found that 500 diabetics had a slightly higher systolic pressure but a slightly lower diastolic pressure than a control group. Ostrander, et al, (1969), in the population survey of 5000 persons at Tecumseh, Michigan, found the blood pressure of 33 diabetic men to be normal, but hypertension was commoner than expected in 54 diabetic women. In another population study done in South Wales (Cochrane, et al, 1960), the mean diastolic pressure of 35 diabetics was the same as that of age and sex-matched controls, but the systolic pressure was slightly higher.

Karlefors (1966), studied the resting blood pressure of diabetics and non-diabetics among men and found a significant difference between figures for diabetics with a duration of over 5 years and those of the controls. This will lead one to believe that diabetes and arterial pressure are related and hemce one might expect to find higher blood pressures among patients who had been diabetic for a long time. This does not seem to be the case. Pyke (1968c) reported that both the systolic and diastolic mean blood pressure do increase with age, and are higher in women than men, as is the case with non-diabetics, but they were not significantly higher in diabetics of long standing than in newly diagnosed cases.

Ferrier (1964), studied the radiologically demonstrable arterial calcification in diabetes mellitus. The legs of 250 diabetics and 250 non-diabetics of similar age and sex distribution were radiographed. He found that medial calcification (which often occurs in an otherwise normal artety) was twice as common in the diabetics, but intimal calcification, which is more significant as an index of arterial degeneration, was only slightly commoner. Moreover, he demonstrated that the frequency of all calcification in the legs was highly correlated with age, being about twice as common at 65 as at 45, and with sex, being about twice as common in men as in women. However, the correlation with duration of diabetes was not convincing.

Signs of peripheral arterial disease, especially those affecting the legs, are common in diabetics. In one group of diabetics studied by Lewis and Symons (1958), intermittent claudication or gangrene was found in 17 per cent. But there is the fact that all these patients were over the age of 40,

Table 46: Hypertensive Diseases and Diseases of peripheral Vascular System among 765 patients at time of first attendance and at end of observation period *

Diseases	"NO DURATION"				"DURATION"			
	MALES		FEMALES		MALES		FEMALES	
	First Attendance	End of Period	First Attendance	End of Period	First Attendance	End of Period	First Attendance	End of Period
Hypertension	36	37	53	56	4	4	7	7
Hypertensive Diseases (heart & renal)	2	2	7	7	1	1	0	0
Arteriosclerosis	19	20	13	13	2	2	4	4
Per. Art. Dis. & Gang.	10	11	4	4	0	0	1	1
Pulm.Embolism & Infarction	1	2	2	2	1	1	1	0
Phlebitis & Thrombo. phlebitis	3	2	3	1	0	0	2	2
Varicose veins	3	3	9	7	1	1	1	2
Haemorrhoids	1	1	4	2	0	0	1	1
Number of patients with diseases	62	64	75	74	6	6	13	12
Per cent of total patients	21.2	21.8	20.3	20.1	11.8	11.8	25.0	23.1

* includes conditions present in dead at time of death

and many were elderly. Two other factors contribute to the difficulty of forming an opinion concerning the frequency of peripheral arterial disease among diabetics. One is the fact that clinical manifestation of these diseases may depend not only upon arterial insufficiency but upon neuropathy, infection and trauma. The second factor concerns the definition of terms used. Intermittent claudification for example, is not the only manifestation of arterial disease in the legs. There may be no symptoms of arterial insufficiency, but the arterial pulses at the foot may be absent.

Among our patients, sign of arterial disease was found much oftener (peripheral arterial disease, Table 46), than a history (symptoms) of intermittent claudication, combined with signs of absent arterial pulses which appeared in Table 41.

Age certainly is associated with an increased tendency to arterial diseases among diabetics (Tables 22 and 23 in Appendix). The prevalence of arterial diseases rises steeply with increasing age. Arterioscletosis and peripheral arterial diseases and gangrene are strikingly related to the age of the patient. Out of the 765 patients, only one below the age of 40 had signs of absent pulsation in the legs. Arteriosclerosis and peripheral arterial diseases were uncommon below 60 years of age, especially in women. However, at the time of first attendance among the newly diagnosed patients in the age group 60-79, peripheral arterial disease and arterioscletosis were present in 22 out of 144 men, and in 15 out of 216 women.

Table 46 shows that for all ages peripheral arterial disease and arteriosclerosis is commoner in men than in women diabetics, especially so in case of peripheral arterial disease. It is believed that diabetic women have less tendency to major arterial obstruction and intermittent claudication than diabetic men. However, in later life this is less true. There was no consistent relationship between arterial diseases and duration of diabetes.

From Table 46 it is seen that hypertension* is the commonest of all diseases listed and was present in 58.1 per cent of the 62 males and in 70.7 per cent of the 75 females who had hypertensive and peripheral vascular diseases at the time of diagnosis. The higher incidence of hypertension in women was maintained at the end of the observation period. However, duration of diabetes seems to have little effect on the development of hypertension and the observed increase during the follow-up period might be attributed to the concomittant ageing of patients. (Table 47).

Table 47: Percentage of 765 patients with hypertension

	"No Duration"		"Duration"	
	Males	Females	Males	Females
First attendance	12.3	14.5	7.8	13.5
End of observation period	12.6	15.2	7.8	13.5

* The diagnosis of hypertension was ascertained from the patients' case notes, the diastolic blood pressure generally being above 100 mm. mercury.

The higher number (percentage) of patients with hypertension among newly diagnosed in comparison with those of the "Duration" group, may be explained by the fact that the latter group contains more young patients than the "No duration" group.

The higher incidence of hypertension in females is confined to those over the age of 60 years, as seen from Table 48. Hypertension is slightly commoner in males than in females below 60 years of age. This is also the case in non-diabetics.

Table 48: Number of newly diagnosed patients with hypertension (662 patients)

Age Group	At first attendance				At end of observation period			
	Males		Females		Males		Females	
	No.	%	No.	%	No.	%	No.	%
40-59	14	15.2	13	13.1	15	16.3	14	14.1
60+	22	14.3	40	17.1	22	14.3	42	18.0

Diseases associated with Diabetes Mellitus

Table 49 shows the frequency of diseases commonly associated with diabetes mellitus in the 775 patients at their first attendance at the clinic.

Table 49: Diseases associated with diabetes present at first attendance in 775 patients (Number and per cent of total patients)

Diseases and conditions present	"No Duration"				Duration"			
	Males		Females		Males		Females	
	No.	%	No.	%	No.	%	No.	%
Cataract	17	5.7	43	11.5	7	13.7	8	15.4
Thyroid disease	2	0.7	16	4.3	1	2.0	3	5.8
Pernicious anaemia	3	1.0	9	2.4	0	-	1	1.9
Isch.Heart disease	44	14.7	49	13.1	5	9.8	5	9.6
Per.Art.Dis. and Arterio-sclerosis	22	7.4	11	3.0	1	2.0	3	5.8
Long term steroid therapy	5	1.7	18	4.8	1	2.0	0	-
Carcinoma of pancreas	3	1.0	3	0.8	0	-	0	-
Other causes of secondary diabetes	0	-	2	0.5	0	-	0	-
Patients with diseases	82	27.4	133	35.7	15	29.4	16	30.8
Total number of patients	299		373		51		52	

14.7 per cent of males and 13.1 per cent of females had signs of ischaemic heart disease at time of diagnosis of diabetes, being the most frequently associated disease among the newly diagnosed diabetics.

Among the 103 "Duration" group, a smaller proportion showed ischaemic heart disease at their first attendance (9.8 per cent of males and 9.6 per cent of females). As explained earlier, ischaemic heart diseases among diabetics appear to be related more to the age of patients rather than to the duration of diabetes. A similar picture was seen in the case of arteriosclerosis and peripheral arterial diseases.

Table 24 in Appendix, indicates once more the importance of age factor in determining the association between diabetes and other diseases known to be associated with diabetes. Among the newly diagnosed diabetics, these diseases were present in 4.2 per cent of males and 5.4 per cent of females below the age of 40; while they were present in 38.5 per cent of males and 47.3 per cent of females above the age of 60 years.

Maturation of cataract, nevertheless, is known to be influenced by the duration of diabetes and showed greater prevalence among the "Duration" group, where it was present in 13.7 per cent of males and 15.4 per cent of females. Among the newly diagnosed diabetics, signs of lens opacities were present only in 5.7 per cent of 299 males and 11.5 per cent of 373 females.

Three types of cataract are seen among diabetics: the snowflake, flocculent, or metabolic cataract, which is the classical opacity occurring primarily in juvenile diabetics, and was shown to be significantly correlated with uncontrolled diabetes; this type of cataract is rare; the senile cataract due to sclerosis of the lens nucleus and the most common one observed in adult diabetics; and catarach "complicata" or secondary cataract related to intraocular diseases. Of the three types, senile cataract is by far the most common one. In our study cataract was recorded when there was lens opacities in either eye, and in the majority of cases it was of the senile type.

Senile cataract occurs with the same frequency in the diabetics as in the non-diabetics. Waite and Beetham (1935), studying 2002 diabetics and 457 non-diabetics, reported that in diabetics over the age of 20 years, there was a prevalence of 50 per cent lens opacities. Among the non-diabetics the prevalence was 57 per cent.

Anthonisen (1936), by a series of 1717 operations, had demonstrated that cataract extraction operation was done 15 times more frequently among diabetics than non-diabetics. More recently, Caird, et al (1964), reported that extraction of senile cataract was four to six times more frequent in known diabetics than in non-diabetics. They have studied 1485 cataract extractions carried out in Oxford Eye Hospital in the years 1957-62. Out of 1024 first operations for senile cataract, 110 (10.7 per cent) were on diabetics. Diabetes was discovered as a result of cataract in 31 (28 per cent) of the 110 diabetics or 3 per cent of all patients having a senile cataract extracted, and senile cataract in diabetics tended to be associated with diabetes of long duration. This is contrary to the findings of Waite and Beetham, and to a more recent work done by McGuinness (1967), who found the prevalence of diabetes not to be different in persons with lens opacities from those without such eye changes. He studied a sample of 340 persons of the general population of the Rhondda Fach. Persons with and without lens opacities showed no significant difference in blood-glucose response to 50 gm glucose challenge. McGuinness suggested that diabetes is not such an important cause of lens opacity formation in the general population. Explanation of these variable findings appear simple if one assumes that cataract matures more rapidly in diabetics than in non-diabetics, as stated many years ago by Parsons (1954).

Caird, et al (1964), and Pirie (1965) emphasised the grossly poorer diabetic control in patients having cataract extraction than among the average patients attending a diabetic clinic. This suggests that poor control of diabetes is a factor in the rate of maturation of senile cataract and this supports the belief that senile cataract matures more rapidly in diabetics than in non-diabetics.

Thyroid diseases (hyperthyroidism and hypothyroidism) and pernicious anaemia tended to be present more among females than males of both "Duration" and "No duration" groups of patients. Among the newly diagnosed diabetics thyroid disease was present in 4.3 per cent of females, but only in 0.7 per cent of males at time of diagnosis. 2.4 per cent of females of the same group had pernicious anaemia while it was present in only 1.0 per cent of newly diagnosed males.

Patients with hyperthyroidism give a family history of diabetes rather more often than would be expected by chance. Perlman (1961), studied familial incidence of diabetes in 187 cases of hyperthyroidism, and found that 36 per cent of them had a positive family history of diabetes, compared with 22.5 per cent of matched controls. The significance of this observation is unclear.

Many more female than male diabetics are found to have hyperthyroidism. In Joslin clinic series, of 55 patients with hyperthyroidism in the years 1951-57, there were 41 (75 per cent) women (Kozak, 1971). The association of diabetes mellitus with hypothyroidism is relatively inftequent, and in our study hypothyroidism was present in 2 of the 16 newly diagnosed females and 1 of the 3 females of "Duration" group. On all three occasions the hypothyroidism has been noted following the treatment of hyperthyroidism. The coexistence of diabetes mellitus and pernicious anaemia was first reported by Parkinson in 1910. The frequency with which these two diseases are found together has been reported by Root (1931). Arapakis, et al (1963), reported the incidence of pernicious anaemia in non-diabetics as 1 to 1.25 per 1000, whereas the incidence in diabetics was found in various series to range from 2 to 10 per 1000. The incidence of diabetes in pernicious anaemia patients was two to three times higher than in non-anaemic patients. In Wilkinson (1963) series, pernicious anaemia was present in 78 of 2284 diabetics.

A variety of explanations has been offered for these findings. Angervall, et al (1961) believed that vascular changes were responsible. In 1963, Beckett and Matthews implicated genetic factors; in the same year Moore and Nelson (1963) reported autoantibodies to gastric parietal cells in 22 per cent of 83 diabetics, raising the question of auto-immune mechanism. Since then many authors reported that auto-antibodies to thyroid and gastric parietal cells are found more commonly in patients with insulin-dependent diabetes mellitus than in age and sex matched controls (Unger, et al, 1968; Irvine, et al, 1970; Goldstein, et al, 1970; Lancet, 1970b). Autoimmune disease is thought by some to be an inherited disease (Roitt & Doniach, 1969), and it seems possible that this genetic factor may be linked with that of diabetes mellitus. Gepts (1965) demonstrated lymphocytic infiltration in the islets of Langerhans of a high proportion of patients with juvenile-onset diabetes mellitus.

In our study, 4.3 per cent and 2.4 per cent of newly diagnosed females had clinical manifestation of thyroid disease and pernicious anaemia respectively.

Irvine, et al (1970), showed that among diabetics consulting the diabetic department of the Royal Infirmary, Edinburgh there was an incidence of 5 per cent of latent pernicious anaemia in middle-aged to elderly female diabetics. Thus there is a strong argument for screening female diabetics for intrinsic -factor-antibodies and low serum- vitamin B12 levels.

Among the newly diagnosed patients of our study, 18 (4.8 per cent) out of 373 females and 5 (1.7 per cent) out of 299 males, were receiving steroid therapy as medication for one reason or another at time of discovery of diabetes. Only one diabetic male from the "Duration" group was receiving such therapy at time of his first attendance.

It is known that excess of glucocorticoids converts a latent or potential diabetes into a clinical form of the disease. In some cases, steroid therapy, without any evidence of potential or existing abnormality of carbohydrate metabolism, may initiate a characteristic form of diabetes. The symptoms of thirst and polyuria are often absent and there is little ketonuria. Pruritus vulvae may be the only symptom, and the diagnosis depends on urine and blood tests (Anderson, 1968). However, all the 23 patients in our series had one or more of the known precipitating factors in addition to steroid therapy, e.g. obesity, family history of diabetes.

Carcinoma of the pancreas was present in 6 (3 males and 3 females) newly diagnosed patients at time of discovery of diabetes.

There is a sharp contrast between the incidence of carcinoma of the pancreas in diabetics and the general population. Hoffman (1934) reported that carcinoma of pancreas constituted 3 per cent of cancers studied among the gener al population. Metropolitan Life Insurance Company figures showed for the five year period from 1951 to 1955, that 4.2 per cent of total deaths from malignant disease in industrial policy holders were due to cancer of the pancreas. In the entire United States during the same period, 1,143,231 deaths were reported to be due to malignant disease; 51,161 or 4.5 per cent were due to cancer of the pancreas. These findings among the general population is in sharp contrast to that found among diabetics. Warren, et al, (1966) found that of 435 cancers occurring in various sites in diabetic patients, in 45 (10.3 per cent) the primary site was the pancreas. Moreover, they found that among the total number of 5673 patients with cancer, 179 or only 3.2 per cent was the pancreas the primary site.

The question of whether diabetes may have been caused by the cancer of the pancreas or whether it was present before the development of the cancer, is still debatable. Green, et al, (1958) analysed the clinical and autopsy records of 209 consecutive patients with primary carcinoma of the pancreas. They found that 4.3 per cent were known to be diabetics prior to the onset of symptoms of cancer; in 32 (15.3 per cent) diabetes was found after the onset of the cancer. In at least two-thirds of the 32 patients in whom diabetes was noted after the symptoms of cancer appeared, there did not seem to be enough post-mortem evidence of damage to islet tissue by fibrosis, tumour invasion, or inflammation to account for the development of diabetes. It is believed that carcinoma of the pancreas is not necessarily the cause of diabetes because the tumour is usually situated in the head and body of the gland instead of in the tail of the organ where most of the islet-bearing tissue is located; and judging from results of surgical removal of the pancreas in animals, destruction of almost 90 per cent of this organ is necessary to produce diabetes, requiring very extensive replacement of tumour.

The other causes of secondary diabetes in the two newly diagnosed diabetic females was pituitary dysfunction. In one it was hyperpituitarism (acromegaly). In the other it was hypopituitarism due to pituitary destruction caused by secondary carcinomates deposits from carcinoma of the breast. This patient diagnosed to have postprandial blood glucose value of more than 250 mgm per 100 ml, in June 1970 during the course of investigating her diabetes insipidus. She died at the age of 37 in June 1971.

The association of diabetes insipidus and hypopituitorism with diabetes mellitus is a very rare phenomenon. The development of diabetes in a subject who had been known to be hypopituitary for 20 years was described by Grunberg and Blair (1957). Natelson (1954) reported that the association of diabetes insipidus and diabetes mellitus had been recorded in only 39 patients.

Table 50: Conditions present among 765 patients at their first attendance and at end of observation period

CONDITIONS	"NO DURATION"				"DURATION"			
	MALES		FEMALES		MALES		FEMALES	
	First Attendance	End of Period	First Attendance	End of Period	First Attendance	End of Period	First Attendance	End of Period
Diab.Complications	16	37	25	43	14	14	14	15
Endocrine & Metabolic diseases	5	4	17	16	1	1	4	4
Hypertension & Dis.of peri.vas.system	62	64	75	74	6	6	13	12
Heart Diseases	55	71	86	94	8	11	11	11
Upper Resp. Dis.	3	1	6	2	1	0	1	0
Other Resp.Diseases.	32	34	24	30	4	4	4	5
Digestive System diseases	36	27	34	23	1	1	3	1
Genito Urinary Dis.	27	16	42	17	2	0	2	0
Anaemia & other Haemop.Diseases	8	7	17	16	1	1	1	1
C.V.Diseases	8	17	13	25	1	3	5	8
Diseases of N.S. Sensory Organs & Mental Disease	18	18	31	31	3	3	7	8
Cataract	17	14	43	36	7	6	8	9
Arthritis and Rheumatism	10	10	40	40	3	2	1	1
Neoplasms	11	13	18	26	1	1	1	2
Dis.of Skin & Sub-cutaneous tissue	17	2	18	5	1	0	2	0
Accident ,Injury & Poisoning	5	3	5	1	2	0	0	0
Others	4	4	1	1	0	0	0	0
Patients with one or more conditions	210	191	283	252	36	33	39	37
Percent of Total Patients	71.7	65.2	76.7	68.3	70.6	64.7	75.0	71.2
Total Number of Patients	293	293	369	369	51	51	52	52

Diabetes Complications and other Diseases among Diabetics

In the preceding pages we were describing individual diabetic complications and diseases known to be associated with diabetes. Besides these, any other disease condition among the 765 diabetics will be dealt with collectively in the following discussion. Comparing the presence of these diseases at patients' first attendance at the clinic and at the end of the observation period (or time of death for those who died). The various conditions were recorded according to the International Classification of Diseases (see Appendix B).

71.7 per cent and 76.7 per cent of the newly diagnosed males and females respectively had one or more disease condition in addition to diabetes at time of diagnosis (Table 50) Among the "Duration" group of patients similar proportions had such conditions. 70.6 per cent of males and 75.0 per cent of females of this group had such diseases at time of their first attendance. At the end of the observation period the number of patients having these conditions became less. 65.2 per cent and 68.3 per cent of newly diagnosed males and females respectively were showing one or more conditions at the end of the observation period. The decrease in the number of patients suffering from illnesses other than diabetes was due to the fact that some illnesses were of an acute treatable nature, such as acute upper respiratory infections, urinary tract infections, skin and subcutaneous tissue infections and accidental injuries. These conditions were recorded, if present at the time of first attendance, but not at the end of the observation period unless present at time of death, e.g. broncho-pneumonia was the cause of death in some patients. The leading cause of death in one woman was accidental fall. Other patients suffering from chronic illness such as varicose veins, haemorrhoids, and cataract, have been cured by successful surgical intervention. The difference between the number of patients having a condition at first attendance and that at the end of the period, does not always indicate the number of patients who had been cured of a particular condition. For example, 60 (17 males and 43 females) newly diagnosed diabetics presented themselves at first attendance with cataract, 16 of whom had been treated successfully by lens extraction. However, 6 other newly diagnosed patients who had no cataract at the start, developed sign of lens opacities during the observation period, hence the number of patients with cataract at the end of the observation period is shown as 50 patients (14 males and 36 females). On the other hand patients, who at their first attendance had chronic conditions such as ischaemic heart disease, hypertension, cancer, cardiovascular diseases, and specific chronic diabetic complications were recorded as having them again at the end of the period, even when there was remission of symptoms. The increase in the number of patients suffering from such diseases indicates the number of patients who developed these diseases during the observation period.

Evaluation of the effectiveness of the treatment offered to diabetics is beyond the scope of this thesis, but it may be one subject for which the material presented here, be used as a base in a future study. The purpose of presenting other disease conditions among diabetics as it is outlined in Table 50 and subsequent tables, is to illustrate the magnitude of illhealth among diabetics.

From Table 50 it is seen that cardiovascular diseases, including cerebrovascular diseases, stand as the most common conditions present among diabetics at their first attendance, as well as at the end of the observation period. This was true in both "No duration" and "Duration" groups of patients. Diseases of the respiratory system, digestive system, genito urinary system, and diseases of skin and subcutaneous tissue showed high prevalence among patients at their first attendance, but since most of the diseases included under these categories were acute treatable infections, at the end of the period the number of patients decreased to an appreciable extent. On the other hand, patients with chronic diseases such as cerebrovascular diseases and diabetic complications increased in number during the observation period. Among the newly diagnosed the number of patients with cerebrovascular diseases increased from 21 (8 males and 13 females) to 42 (17 males and 25 females), and those with diabetes complications increased from 41 to 80.

Disease conditions among diabetics were present more in those above the age of 60 years (Table 51).

Table 51/

Table 51: Percentage of patients with one or more disease condition according to sex and age groups

	Males		Females	
	< 60 yrs.	60+	< 60 yrs	60+
	"No Duration" Group			
First attend.	53.2	88.3	60.0	86.3
End of obser. period	43.9	84.4	45.2	81.6
Total number of patients .	139	154	135	234
	"Duration" Group			
First attend.	64.1	91.7	64.5	90.5
End of obser. period	56.4	91.7	61.3	85.7
Total number of patients	39	12	31	21

At the patients' first attendance, among the newly diagnosed below the age of 60, these conditions were present in 53.2 per cent of males and 60.0 per cent of females. Above the age of 60 years, 88.3 per cent of males and 86.3 per cent of females had one or more disease condition. A similar pattern is noted for the "Duration" group, but with slightly higher proportions of patients being involved. The effect of age on the presence of these diseases among diabetics is also clear from the fact that the decrease in the number of patients at the end of the period was more pronounced in those below the age of 60 years. For example, the decrease in newly diagnosed females was from

60.0 per cent to 45.2 per cent for those below 60 years, while it only decreased from 86.3 per cent to 81.6 per cent for females above the age of 60. This suggests that more chronic diseases are present among the elderly than the young diabetics. This is what one would expect to find among the general population.

Tables 25-31 in the Appendix deal with the presence of seven disease conditions among 662 newly diagnosed diabetics according to sex and broad age groups (below 60 and above 60 years of age). The disease conditions were subdivided into individual diseases, and each table deals with small number of patients. Nevertheless, these tables show the trend of diseases among diabetics, which seems not so different from what would be found among non-diabetics of similar age groups.*

Diseases of respiratory system; digestive system; genito-urinary system; cerebrovascular system; nervous, sensory and mental disorders; musculo-skeletal system; and neoplasms were present more among patients above the age of 60 years than among those below 60. Moreover, the increase in the number of diabetics suffering from chronic diseases over the period of follow-up was commoner among patients above the age of 60 years.

The majority of newly diagnosed diabetics as well as those of the "Duration" group, had one or more condition at the time of their first attendance. At least one condition (diabetes complications not counted), in addition to diabetes was present in 72.4 per cent of newly diagnosed patients, and in 63.1 per cent of patients from the "Duration" group of patients (Table 52).

Table 52: Percentage distribution and cumulative per cent of diabetes by number of conditions present at time of first attendance according to sex; 765 patients

With "No Duration" = (662 patients)

No. of conditions present	Males		Females		Both Sexes	
	Per cent distribution					
All Diabetics	(293)	100	(369)	100	(662)	100
Diabetes only (no diab. complication)	(83)	28.33	(86)	23.31	(169)	25.53
Diabetes with diab. complication only	(5)	1.71	(9)	2.44	(14)	2.12
Diabetes + 1 condition	(128)	43.69	(130)	35.23	(258)	38.97
Diabetes + 2 or more conditions	(77)	26.28	(144)	39.02	(221)	33.38
	Cumulative per cent					
2+ conditions		26.28		39.02		33.38
1+ conditions		69.97		74.25		72.35
All diabetics		100		100		100

"With Duration" (103 patients)

No. of conditions present	Males		Females		Both Sexes	
	Per cent distribution					
All diabetics	(51)	100	(52)	100	(103)	100
Diabetes only (no diab. complications)	(15)	29.41	(13)	25.00	(28)	27.18
Diabetes with diab. complication only	(7)	13.73	(3)	5.77	(10)	9.71
Diabetes + 1 condition	(19)	37.26	(15)	28.85	(34)	33.01
Diabetes + 2 or more conditions	(10)	19.61	(21)	40.39	(31)	30.10
	Cumulative per cent					
2+ conditions		19.61		40.39		30.10
1+ conditions		56.87		69.24		63.11
All diabetics		100		100		100

Figures in brackets = number of patients

Table 53: Percentage distribution and cumulative per cent of diabetes by number of conditions present at end of observation period, according to sex, 765 patients

With "No Duration" (662 patients)

No. of conditions present	Males		Females		Both Sexes	
			Per cent distribution			
All Diabetics	(293)	100	(369)	100	(662)	100
Diabetes only (no diab. complications)	(102)	34.81	(117)	31.71	(219)	33.08
Diabetes with diab. complication only	(18)	6.14	(14)	3.79	(32)	4.83
Diabetes + 1 condition	(86)	29.35	(103)	27.91	(189)	28.55
Diabetes + 2 or more conditions	(87)	29.69	(135)	36.59	(222)	33.53
			Cumulative per cent			
2+ conditions		29.69		36.59		33.53
1+ conditions		59.04		64.59		62.08
All diabetics		100		100		100

With "Duration" (103 patients)

No. of conditions present	Males		Females		Both Sexes	
			Per cent distribution			
All Diabetics	(51)	100	(52)	100	(103)	100
Diabetes only (no diab. complications)	(18)	35.29	(15)	28.85	(33)	32.04
Diabetes with diab. complication only	(5)	9.80	(2)	3.85	(7)	6.80
Diabetes + 1 condition	(20)	39.22	(17)	32.69	(37)	35.92
Diabetes + 2 or more conditions	(8)	15.69	(18)	34.62	(26)	25.24
			Cumulative per cent			
2+ conditions		15.69		34.62		25.24
1+ conditions		54.91		67.31		61.16
All diabetics		100		100		100

Figures in brackets = number of patients

Tables 52 and 53 show the per cent distribution and cumulative per cent of diabetes by number of conditions present at time of first attendance, and at the end of observation period.

Diabetic patients with diabetes alone, were divided into two categories: those with no diabetes complications and those with diabetes complications. Patients belonging to the latter category were few in number, especially among the newly diagnosed diabetics (1.71 per cent of males and 2.44 per cent of females at first attendance). However, their numbers increased to account for 6.14 per cent and 3.79 per cent of males and females respectively, at the end of the observation period. There was an apparent but no real decrease among the "Duration" group who had diabetes complications only at the end of the period, compared with those present at their first attendance. (The number of diabetics with diabetes complication at first attendance was 10 patients, but this decreased to 7 at the end of the period). The three patients had developed other diseases during the observation period and at the end of the period were included among those who had one or more condition besides diabetes.

About a third of the patients had two or more conditions in addition to diabetes at their first attendance. 26.3 per cent and 39.0 per cent of newly diagnosed males and females respectively, had two or more conditions besides diabetes at time of diagnosis.

Among the "Duration" group, 19.61 per cent of males and 40.39 per cent of females had two or more conditions at time of their first attendance. At the end of the observation period there was an overall decrease in the proportion of patients showing one or more conditions among both the newly diagnosed and "Duration" groups of patients. Both males and females of the "Duration" group, and females from the newly diagnosed group, who had two or more conditions, showed a decrease at the end of the period. However, among the "Duration" group there was an increase during the period of observation in those patients who had only one condition besides diabetes. Their proportion increased from 33.0 per cent at first attendance to 35.9 per cent at end of the period. The increase was more among females than males. Moreover, males of the newly diagnosed group who had two or more conditions at time of diagnosis, showed an increase during the period of observation. The increase was from 26.3 per cent to 29.7 per cent.

Females had significantly more disease conditions than males, both among the newly diagnosed and "Duration" group of patients. This is true at time of first attendance and at the end of observation period. At time of first attendance two or more disease conditions among diabetics were present in 39.0 per cent of newly diagnosed females, and 40.4 per cent of females from the "Duration" group, while two or more conditions were present in only 26.3 per cent and 19.6 per cent of males of the newly diagnosed and "Duration" groups respectively.

Data from the U.S.National Health Interview Survey (1967) for the year 1964-1965, had shown that 80.1 per cent of diabetics had one or more chronic condition beside diabetes at time of

Table 54 : Percentage Distribution and Cumulative per cent of diabetics by number of conditions present at first attendance (alive only) = 669 patients

With "No Duration" 581 patients)

Number of conditions present	Males		Females		Both Sexes	
			Per cent Distribution			
All Diabetics	(252)	100	(329)	100	(581)	100
Diabetes only (no diab. complications)	(82)	32.54	(82)	24.92	(164)	28.23
Diabetes with diab. complications only	(4)	1.59	(8)	2.43	(12)	2.07
Diabetes + 1 condition	(111)	44.05	(120)	36.47	(231)	39.76
Diabetes + 2 or more conditions	(55)	21.83	(119)	36.17	(174)	29.95
			Cumulative Per Cent			
2+ conditions		21.83		36.17		29.95
1+ conditions		65.88		72.64		69.71
All diabetics		100		100		100
	With "Duration" (88 patients)					
			Per cent Distribution			
All Diabetics	(46)	100	(42)	100	(88)	100
Diabetes only (no diab. complications)	(14)	30.43	(13)	30.95	(27)	30.68
Diabetes with diab. complications only	(7)	15.22	(2)	4.76	(9)	10.23
Diabetes + 1 condition	(18)	39.13	(12)	28.57	(30)	34.09
Diabetes + 2 or more conditions	(7)	15.22	(15)	35.71	(22)	25.00
			Cumulative per cent			
2+ conditions		15.22		35.71		25.00
1+ conditions		54.35		64.28		59.09
All diabetics		100		100		100

Figures in brackets = number of patients

Table 55 : Percentage distribution and cumulative percentage of diabetics by numbers of conditions present at end of observation period, 669 patients (alive only)

With No Duration (581 patients)						
No. of conditions present	Males		Females		Both Sexes	
			Per cent distribution			
All Diabetics	(252)	100	(329)	100	(581)	100
Diabetes only (no diab. complications)	(102)	40.48	(117)	35.56	(219)	37.69
Diabetes (with diab. complications only)	(18)	7.14	(13)	3.95	(31)	5.34
Diabetes + 1 condition	(78)	30.95	(92)	27.96	(170)	29.26
Diabetes + 2 or more conditions	(54)	21.43	(107)	32.52	(161)	27.71
			Cumulative per cent			
2+ conditions		21.43		32.52		27.71
1+ conditions		52.38		60.48		56.97
All diabetics		(100)		(100)		(100)

With Duration (88 patients)						
			Per cent distribution			
All Diabetics	(46)	100	(42)	100	(88)	100
Diabetes only (no diab. complications)	(18)	39.13	(15)	35.71	(33)	37.50
Diabetes (with diab. complications only)	(5)	10.87	(2)	4.76	(7)	7.95
Diabetes + 1 condition	(18)	39.13	(14)	33.33	(32)	36.36
Diabetes + 2 or more conditions	(5)	10.87	(11)	26.19	(16)	18.18
			Cumulative per cent			
2+ conditions		10.87		26.19		18.18
1+ conditions		50.00		59.52		54.54
All diabetics		100		100		100

Figures in brackets = number of patients

Table 56 : Percentage distribution and cumulative per cent of diabetics by number of conditions present at first attendance by sex, 96 patients who died during the observation period

No. of conditions present	Males		Females		Both Sexes	
	With "No Duration" (81 patients)					
	Per cent distribution					
All diabetics	(41)	100	(40)	100	(81)	100
Diabetes only (no diab. complications)	(1)	2.44	(4)	10.00	(5)	6.17
Diabetes with diab complications only	(1)	2.44	(1)	2.50	(2)	2.47
Diabetes + 1 condition	(17)	41.46	(10)	25.00	(27)	33.33
Diabetes + 2 or more conditions	(22)	53.66	(25)	62.50	(47)	58.02
	Cumulative per cent					
2+ conditions		53.66		62.50		58.02
1+ conditions		95.12		87.50		91.35
All diabetics		100		100		100
	With "Duration" (15 patients)					
	Per cent distribution					
All diabetics	(5)	100	(10)	100	(15)	100
Diabetes only (no diab. complications)	(1)	20.00	(0)	0.00	(1)	6.67
Diabetes with diab. complications only	(0)	0.00	(1)	10.00	(1)	6.67
Diabetes + 1 condition	(1)	20.00	(3)	30.00	(4)	26.67
Diabetes + 2 or more conditions	(3)	60.00	(6)	60.00	(9)	60.00
	Cumulative per cent					
2+ conditions		60.00		60.00		60.00
1+ conditions		80.00		90.00		86.67
All diabetics		100		100		100

Figures in brackets = number of patients

Table 57: Percentage distribution and cumulative per cent of diabetics by number of conditions present at time of death in 96 patients who died during the observation period

No. of conditions present	With "No Duration" (81 patients)					
	Males		Females		Both Sexes	
	Per cent distribution					
All diabetics	(41)	100	(40)	100	(81)	100
Diabetes only (no diab. complications)	(0)	0.00	(0)	0.00	(0)	0.00
Diabetes with diab. complications only	(0)	0.00	(1)	2.50	(1)	1.23
Diabetes + 1 condition	(8)	19.51	(11)	27.50	(19)	23.46
Diabetes + 2 or more conditions	(33)	80.49	(28)	70.00	(61)	75.31
	Cumulative per cent					
2+ conditions		80.49		70.00		75.31
1+ conditions		100.00		97.50		98.77
All diabetics		100		100		100
	With "Duration" (15 patients)					
	Percent Distribution					
All diabetics	(5)	100	(10)	100	(15)	100
Diabetes only (no diab. complications)	(0)	0.00	(0)	0.00	(0)	0.00
Diabetes with diab. complications only	(0)	0.00	(0)	0.00	(0)	0.00
Diabetes + 1 condition	(2)	40.00	(3)	30.00	(5)	33.33
Diabetes + 2 or more conditions	(3)	60.00	(7)	70.00	(10)	66.67
	Cumulative per cent					
2+ conditions		60.00		70.00		66.67
1+ condition		100.00		100.00		100.00
All diabetics		100		100		100

Figures in brackets = number of patients

interview. Over half of the diabetics (57.9 per cent) reported two or more chronic conditions. About 62.3 per cent of female diabetics reported two or more chronic conditions contrasted with 51.9 per cent of males.

Tables 54-57 demonstrate the disease conditions present among diabetic patients at first attendance (Tables 54 and 56), and at the end of the observation period (Tables 55 and 57), for patients who remained alive at the end of the period (Tables 54 and 55), compared with conditions present among patients who died during the period (Tables 56 and 57).

The presence of one or more conditions as well as two or more conditions were more common among the dead patients, both at the patients first attendance and at the end of the observation period. This was true for both groups, the newly diagnosed and the "Duration" patients.

The association, of one or more conditions with diabetes among dead patients compared with those present among patients who remained alive at the end of the period, was a significant one, both at time of first attendance and at the end of the period. Table 58 shows the association between conditions present among the dead and survival of the newly diagnosed group (662) at time of their first attendance (time of diagnosis).

The association was significant in both males and females. One or more conditions in addition to diabetes were over-represented among those who died within a short period of the discovery of diabetes. This suggests that diabetics with more illnesses at the time when they start to develop diabetes symptoms have poor prognosis for survival.

Table 58: The association of one or more disease conditions among 662 newly diagnosed diabetics at time of diagnosis, according to sex and status at the end of short period of follow-up (1-4 years).

Conditions present at time of diagnosis	MALES						FEMALES					
	Died		Survived		Total		Died		Survived		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Diabetes only, with or without compli-cation	2	2	86	98	88	100	5	5.3	90	94.7	95	100
Diabetes + 1 condition	17	13.3	111	86.7	128	100	10	7.7	120	92.3	130	100
Diabetes + 2 or more conditions	22	28.6	55	71.4	77	100	25	17.4	119	82.6	144	100
Number of patients	41		252		293		40		329		369	
	Chi square = 23.6, d.f. = 2 significant at 0.0005 level						Chi square = 10.7, d.f. = 2 significant at 0.005 level					

Individual disease conditions were present in higher proportions among patients who died, than among those who survived over the observation period. At the time of diagnosis, among the newly diagnosed diabetics, heart diseases were present in 44.5 per cent of the 81 patients who died, while only 18.1 per cent of 581 patients who remained alive had heart diseases at time of diagnosis (Table 59). Similarly, hypertension and diseases of peripheral vascular system were present in 40.7 per cent of those who died, but only in 17.9 of the survival patients. At time of diagnosis

Table 59: Selected disease conditions among 662 newly diagnosed diabetics present at time of diagnosis according to status at end of the observation period.

Diseases present at time of diagnosis	Survived		Died		Total	
	No.	%	No.	%	No.	%
			M A L E S			
Diabetes complications	12	4.8	4	9.8	16	5.5
Hypertension & Dis. of peri. vascular system	44	17.5	18	43.9	62	21.2
Heart diseases	39	15.5	16	39.0	55	18.8
Respiratory system dis.	29	11.5	5	12.2	34	11.6
Genito-urinary diseases	20	7.9	7	17.1	27	9.2
Cerebro-vascular diseases	4	1.6	4	9.8	8	2.7
Cataract	8	3.2	9	22.0	17	5.8
Digestive system dis.	32	12.7	4	9.8	36	12.3
Total number of patients	252		41		293	
			F E M A L E S			
Diabetes complications	23	7.0	2	5.0	25	6.8
Hypertension & dis. of peri.vascular system	60	18.2	15	37.5	75	20.3
Heart diseases	66	20.1	20	50.0	86	23.3
Respiratory system dis.	28	8.5	3	7.5	31	8.4
Genito-urinary diseases	39	11.9	3	7.5	42	11.4
Cerebro-vascular diseases	11	3.4	2	5.0	13	3.5
Cataract	36	11.0	7	17.5	43	11.7
Digestive system dis.	31	9.4	3	7.5	34	9.2
Total number of patients	329		40		369	

cerebrovascular diseases were present in 7.4 per cent of those who died, while they were present in only 2.6 per cent of those who remained alive.

Table 59 illustrates the presence of selected disease conditions among 662 newly diagnosed diabetics at time of their first attendance according to status of patients at end of the observation period. Eight conditions (including diabetes complications) were selected because of their frequent occurrence among diabetics. Chronic conditions present most often were heart conditions (18.8 per cent of males and 23.3 per cent of females); hypertension and peripheral vascular diseases (21.2 per cent of males and 20.3 per cent of females); cataract (5.8 per cent of males and 11.7 per cent of females); cerebrovascular diseases (2.7 per cent of males and 3.5 per cent of females). The presence of all these disease conditions were commoner among patients who died at the end of the observation period. For example, among men, cataract was present in 22.0 per cent of those who later died, but only in 3.2 per cent of those who survived. Among women, heart diseases were present in 50 per cent of those who died, in contrast with 20.1 per cent in those who remained alive. It appears that among the newly diagnosed diabetics, survival is related to the presence of associated chronic diseases at time of discovery of diabetes.

Diabetes was associated with two or more conditions in 75.3 per cent of dead patients (71 out of 96), at time of death. Moreover, among all those who died (96 patients) but one, diabetes was associated with the presence of at least one disease condition

Table 60 : Selected disease conditions among 662 newly diagnosed diabetics present at time of diagnosis according to type of referral to the diabetic clinic

Diseases present at time of diagnosis	Outpatients		Inpatients		G.T.T.Group		Total	
	No.	%	No.	%	No.	%	No.	%
M A L E S								
Diabetic complications	9	4.7	6	15.8	1	1.6	16	5.5
Hypertension & dis. of peri. vascular system	42	21.8	7	18.4	13	21.0	62	21.2
Heart diseases	36	18.7	9	23.7	10	16.1	55	18.8
Respiratory system dis.	23	11.9	4	10.5	7	11.3	34	11.6
Genito-urinary diseases	14	7.3	8	21.1	5	8.1	27	9.2
Cerebro-vascular dis.	7	3.6	0	-	1	1.6	8	2.7
Cataract	11	5.7	3	7.9	3	4.8	17	5.8
Digestive system dis.	24	12.4	5	13.2	7	11.3	36	12.3
Total number of patients	193		38		62		293	
F E M A L E S								
Diabetic complications	14	5.3	10	18.5	1	2.0	25	6.8
Hypertension & dis. of peri.vascular system	59	22.2	9	16.7	7	14.3	75	20.3
Heart diseases	50	18.8	23	42.6	13	26.5	86	23.3
Respiratory heart dis.	15	5.6	3	5.6	13	26.5	31	8.4
Genito-urinary dis.	19	7.1	14	25.9	9	18.4	42	11.4
Cerebro-vascular dis.	8	3.0	5	9.3	0	-	13	3.5
Cataract	30	11.3	8	14.8	5	10.2	43	11.7
Digestive system dis.	24	9.0	6	11.1	4	8.2	34	9.2
Total number of patients	266		54		49		369	

at time of death (Table 57). Table 57 suggests that diabetes with its complications, but without any other disease conditions, was present at time of death in only one woman. Even in this single case, the cause of death (gangrene of foot) could be disputed as to whether it was due entirely to diabetes. Gangrene of foot in a woman of 67 years, with a duration of only 3 years as diabetic could be associated with arteriosclerotic degeneration changes of old age. It is shown in Table 32 in Appendix that among the newly diagnosed patients, 16.3 per cent of the 92 who were in hospital as "Inpatients", died within the observation period. While only 11.6 per cent of 466 "outpatients" and 10.5 per cent of "G.T.T." patients died during the same period. The cause of hospitalisation among the "Inpatients" varied, but in the majority of patients it was because of diseases other than diabetes, and diabetes was discovered while investigating the patients' original complaints.

Table 60 indicates that 92 newly diagnosed patients who were referred to the clinic while in hospital, had the highest proportion of the disease conditions listed, compared with those patients of the "Outpatients" and "G.T.T." groups.

Heart diseases were present in 34.8 per cent of the "Inpatients" group (23.7 per cent of males and 42.6 per cent of females), while they were present in 18.7 per cent and 20.7 per cent of the "Outpatients" and "G.T.T." groups respectively. Cataract was present in 12.0 per cent of the "Inpatients" group, but in 8.9 per cent and 7.2 per cent of the "Outpatients" and "G.T.T." groups respectively. Similarly, the highest proportion of patients

Table 61: Selected disease conditions among 662 newly diagnosed diabetics present at time of diagnosis according to type of diabetes.

Diseases present at time of diagnosis	Insulin Dependent		Insulin Independent		Total	
	No.	%	No.	%	No.	%
MALES						
Diabetes complications	5	10.4	11	4.5	16	5.5
Hypertension & disease of peri.vascular syst.	2	4.2	60	24.5	62	21.2
Heart diseases	0	-	55	22.5	55	18.8
Respiratory system dis.	4	8.3	30	12.2	34	11.6
Genito-urinary dis.	4	8.3	23	9.4	27	9.2
Cerebro-vascular dis.	0	-	8	3.3	8	2.7
Cataract	0	-	17	6.9	17	5.8
Digestive system dis.	5	10.4	31	12.7	36	12.3
Total number of patients	48		245		293	
FEMALES						
Diabetes complications	6	15.0	19	5.8	25	6.8
Hypertension & dis. of peri.vascular system	2	5.0	73	22.2	75	20.3
Heart diseases	2	5.0	83	25.2	86	23.3
Respiratory system dis.	6	15.0	25	7.6	31	8.4
Genito-urinary dis.	6	15.0	36	10.9	42	11.4
Cerebro-vascular dis.	0	-	13	4.0	13	3.5
Cataract	2	5.0	41	12.5	43	11.7
Digestive system dis.	5	12.5	29	8.8	34	9.2
Total number of patients	40		329		369	

affected were among the "Inpatients" group for diabetes complications, genito-urinary system diseases, digestive system diseases, diseases of cerebrovascular system, and cataract. Hypertension and peripheral vascular system diseases showed a higher incidence among the "Outpatients" group (22.0 per cent), while these diseases were present in 17.4 per cent and 18.0 per cent of patients from the "Inpatients" and "G.T.T." groups respectively.

Disease conditions listed were present in a proportional number of patients who belong to the "G.T.T." group. Respiratory system diseases were more common in this group than in the other two groups. Heart diseases were more common in the "G.T.T." patients (20.7 per cent), than in the "Outpatients" group (18.7 per cent). The presence of disease conditions in proportional number of those who needed glucose tolerance tests to confirm the diagnosis of diabetes suggest that diabetes as manifested by the degree of hyperglycaemia has little or no obvious causal relation on the presence of other disease conditions among the newly diagnosed diabetics. This brings us to discuss the effect of type of diabetes on the occurrence of disease conditions frequently present among newly diagnosed diabetics (Table 61).

Among the newly diagnosed men, apart from diabetes complications, all disease conditions listed were more common among the insulin-independent than among the insulin-dependent patients. Among the newly diagnosed women the same was true for most of the disease conditions.

Diabetes complications at time of diagnosis, on the other hand, were present more among the insulin-dependent than among the insulin-independent patients, and is seen in both men and women. This is largely due to the fact that a large proportion of diabetes complications at time of diagnosis were diabetic coma and precoma, which are known to occur more among the insulin-dependent patients who are prone to such complications.

Disease conditions other than diabetes, associate themselves more among the "milder" insulin-independent patients. Being present in higher proportion among the elderly insulin-independent patients at time of diagnosis, these diseases seem to bear no relation to the degree of "severity" of diabetes. Diabetes complications on the other hand, were present more among those who are insulin-dependent, and are associated with those diabetics who need insulin to regulate their metabolic defect.

From looking at the relation of the weight of patients and the presence of disease conditions among the newly diagnosed, the same trend was noted. Diabetes complications have the highest incidence among the thin, underweight patients who are more insulin-dependent and of a younger age group. However, among the overweight patients there was a reduction in diabetes complications but an increase of other disease conditions at time of diagnosis. This is mainly a reflection on the one hand of the large number of patients who are insulin-independent, and on the other hand their heavy weighting at the latter end of the age scale.

Classifying the patients according to their economic position shows that the economically-inactive patients have a higher incidence of disease conditions than does those who are economically-active. Here again, the age of the patients is the prime factor.

Economically-inactive patients were shown to be composed mainly of old patients who are retired men and women occupied by household duties.

It was not sufficiently appreciated in the past that so many of the associations that have been made between diabetes and other chronic diseases are due to more or less the advanced age of diabetics at diagnosis. One would expect on this account alone (as one observes), a much higher incidence of heart diseases, hypertension, and cerebrovascular diseases in diabetics than in the normal population, and also more of these diseases in insulin-independent diabetics, obese diabetics, and economically-inactive diabetics. Older diabetics come to the attention of the medical profession because of their complaints of other diseases, and diabetes was discovered incidentally among them. Among these patients, chronic diseases were present in high proportions, and this can be seen in the difference of the incidence of chronic diseases between the "G.T.T." patients and the hospital "Inpatients" groups on the one hand, and the "Outpatients" group on the other.

Causes of Death in Newly Diagnosed Diabetics

Diabetes is a permanent state terminated only by death. However, the overwhelming majority of patients die with diabetes, rather than from diabetes. This became more true after the great advances which have been made in the field of medical treatment during the last half century. The discovery of insulin and antibiotics reduced the mortality from diabetes ketoacidosis and inter-current infections, which were responsible for both the high mortality and the short duration of survival of diabetics in the last. In addition to the influence of insulin and antibiotics, the better understanding of diabetic dietary treatment, as well as advances in treatment of infections and surgical complications, have been important factors. When age at onset is considered, the progress is even more impressive as evidenced by the tenfold increase in the duration of the life of persons who develop diabetes as children (Root, 1965). With increased longevity among diabetics, as well as among the general population, diabetes became associated with chronic diseases of old age. Hence the causes of disabilities and death among the majority of diabetics are those of the older section of the population in general.

Thanks to the late E.P.Joslin, who kept full records of his diabetic patients from the year 1897 when he started to practice, it is possible to determine the trend in mortality during the last 70 years. Between the period 1897-1914 and 1957, the average duration of diabetes at death rose from 4.9 to 18.2 years. In the former period 19.4 per cent of all diabetics died within one year of diagnosis and 66.8 per cent in less than 5 years, whereas by 1957 only 1.6 per cent died in the first year, and 9.0 per cent in less than 5 years.

Mortality among old diabetics has been shown not to be much higher than that among the general population of the same ages (Werrasinghe, 1962; Hayward & Lucerna, 1965), while mortality rates among the younger diabetics was shown to be significantly higher than that of comparable ages of the general population.

All newly diagnosed diabetics referred to the diabetic clinic at the Birmingham General Hospital in the years 1945-1959 (6016 patients), have been followed up to the end of 1959. The mortality rates were compared with those of the population of West Midland conurbation for the year 1951-1952. Diabetic mortality was greater than in the general population at all ages, though not as excessive among the old as it was among the younger diabetics. The actual mortality of diabetics expressed as a percentage of that expected in the general population for those aged 20-39 was 196 per cent and 648 per cent for men and women respectively. For those aged 70 years and over it was 129 per cent and 144 per cent for men and women respectively (Malins, 1966). Women fare worse than men, and the heaviest excess occurred in young women. However, at younger age groups figures of actual death were small (in age group 20-39, the number of actual deaths was 8 men and 15 women), and hence were very sensitive to small variation in the num ber of deaths. Birmingham Actuarial Society Study had also demonstrated the effect of duration of diabetes, since diagnosis, on the mortality trend. The trend was towards an increase in mortality as the duration of diabetes increased. The longest duration of diabetes in their study was 15 years. Mortality among those with a duration of 10-14 years, who were diagnosed in 1945-1949 was higher than that of patients with a duration of 0-4 years, who were diagnosed in 1955-1959. There has been an improvement in mortality at duration 0-4 years, between patients diagnosed in 1945-1949, and those diagnosed in the period 1955-1959.

The mortality of those who, apart from diabetes would have been regarded as class I lives, was much lower than that of patients whose lives were impaired by the presence of other diseases and disabilities. Men with first class lives, aged over 50, who had had diabetes for up to 15 years, had shown no excess mortality over that which is expected.

Other findings in that study were that the mortality of married women exceeded that of spinsters, whereas in the general population the reverse is true; the mortality of diabetics who were overweight at diagnosis was less than for those who were underweight, presumably because of the milder character of diabetes in the obese. Greater mortality was among those who needed insulin for treatment, compared with that among the diet-controlled patients. A somewhat different result was obtained by Warrasinghe (1962). He reported that mortality was commoner in insulin-independent than in insulin-dependent patients. Among 770 deaths studied 47.3 per cent and 39.7 per cent of men and women respectively, were insulin-dependent, while 48.4 per cent and 56.9 percent were controlled on diet alone. Oral treatment was not used on a large scale until 1958 and its effect on mortality was not assessed in the above mentioned studies. University Group Diabetes program (1970), found in their prospective study that high mortality from cardiovascular diseases is associated with patients treated by tolbutamide.

Our present study found that 96 (46 men and 50 women) died out of 775 patients who attended the diabetic clinic during the period 1969-71. The 775 patients were followed up from the time of their first attendance in 1969-71 to the end of 1972. 81 out of the 96 dead patients were newly diagnosed in the period 1969-71, and the other 15 had diabetes for a period before their first attendance in 1969-71. 38 (82.6 per cent) out of 46 men, and 41 (82.0 per cent) out of 51 women who died were above the age of 60 years at time of diagnosis of diabetes (Table 62).

Table 62: Distribution of 96 dead patients according to sex, age at diagnosis, and duration of diabetes from diagnosis till death.

DURATION OF DIABETES IN YEARS

Age at Diagnosis	<1 yr.		1-2 yrs		2-3 yrs		3-5 yrs		5-9 yrs		10+ yrs		"All duration"			
	M	F	M	F	M	F	M	F	M	F	M	F	Males		Females	
													No.	%	No.	%
< 40	0	0	0	1	1	1	0	0	0	0	0	1	1	2.2	3	6.0
40-59	1	1	1	2	2	0	1	0	0	0	2	3	7	15.2	6	12.0
60-79	11	8	13	15	4	4	5	6	1	5	0	0	34	73.9	38	76.0
80+	1	1	1	2	1	0	1	0	0	0	0	0	4	8.7	3	6.0
All ages	13	10	15	20	8	5	7	6	1	5	2	4	46	100.0	50	100.0

Table 62 shows the duration of diabetes from time of diagnosis till death for all the 96 patients according to sex and age at diagnosis.

23 patients died within the same year of diagnosis, 35 died within a period of 1-2 years, after that the number of dead decreases with increased duration. This is due to the fact that the total number of patients followed up decreased in each year of follow up.

Up to the end of 1972, those patients who were diagnosed before 1969 but attended in 1969-71, were followed up for more than four years. Those diagnosed in 1969 were followed for 3-4 years; those diagnosed in 1970 were followed for 2-3 years; and those diagnosed in 1971 were followed for a period of only 1-2 years. All 775 patients who first attended the clinic in 1969-71 were followed for at least one year, up to the end of 1972.

21 patients out of the 23 who died within one year were above the age of 60 at time of diagnosis. All the 23 patients were newly diagnosed in period 1969-71, which means that 3.4 per cent of the 672 newly diagnosed patients died within one year of the discovery of diabetes. However, the majority of those who died within one year were above the age of 60 years. 5.3 per cent (21 out of 393) of those who were above the age of 60 died within the first year of discovery of diabetes, while only 0.7 per cent (2 out of 279) of those below the age of 60, died within the one year period. No patient below the age of 40 died within one year of diagnosis. One woman who died within 2 years of the discovery of diabetes was 37 years old and died from secondary metastasis of carcinoma of the breast.

In spite of the fact that not all patients have been followed for a period of more than one year, the number of those who died within a period of two years (35 patients) was more than the number of deaths in the one year period (23 patients). This suggests that excess mortality may well become even greater in patients having diabetes for a longer time. Because the longest period of follow-up was less than four years, this study cannot throw more light in that direction. However, our study suggests that the majority of patients who die within one year are those who are above the age of 60 at time of discovery of diabetes. 12 of the 13 men and 9 of the 10 women who died within one year were above the age of 60 years.

Death in diabetics within one year period of the time of discovery of diabetes is about eight times greater in those above the age of 60 than in those below 60 years. According to the observation made in Part II of this thesis that the diabetic population changes every ten years (the annual incidence is one-tenth of the overall prevalence, and assuming that the diabetic population remains constant), it appears that such a change is much more rapid as well as more frequent among the old than the young diabetics. This also implies that the annual incidence of diabetes in the elderly would be underestimated if calculated from prevalence of existing cases at one point in time.

Classification of dead patients according to socio-medical charactistics showed a somewhat similar pattern to that of the diabetic population in general.

32 out of 46 men who died were retired men, and 46 out of the 50 women were either retired (10) or occupied by housekeeping duties (36). The majority of dead belonged to Social Class III

(24 men and 24 women). Only 9 patients (4 men and 5 women) were insulin-dependent, while there were 42 and 45 insulin-independent men and women respectively. 27 and 13 out of the 46 men were married and divorced respectively. Widowed women (25) were more than the married (16).

The overweight patients were under-represented among the dead. Those who were underweight or of normal weight (within 10 per cent of standard weight), out-numbered those who were overweight. 34 out of 46 men were either underweight (9) or of normal weight (25). 12 women were underweight and 25 were of normal weight, and the remaining 13 were overweight.

The primary cause of death

Table 63 shows the primary cause of death, coded according to the primary (leading) cause of death mentioned on the death certificate.

Table 63: The primary cause of death in 96 patients according to age (below and above 60 years of age)

Primary cause of death	< 60		60+		All ages	
	No.	%	No.	%	No.	%
Diabetes Mellitus	1	5.9	1	1.3	2	2.1
Diabetes complications	1	5.9	1	1.3	2	2.1
Acute myocardial infarction	4	23.5	25	31.7	29	30.2
Cardiac failure	1	5.9	5	6.3	6	6.3
Other cardiovascular causes	0	-	5	6.3	5	5.2
cerebrovascular accident	2	11.8	12	15.2	14	14.6
Pneumonia	2	11.8	15	19.0	17	17.7
Neoplasms	5	29.4	10	12.7	15	15.6
Other causes	1	5.9	5	6.3	6	6.3
Number of patients	17	100.1	79	100.1	96	100.1

In only 2 patients of the 96, diabetes mellitus was mentioned as the primary cause of death. Diabetes complications were responsible for the death in another 2 patients (ketoacidosis and gangrene of foot).

Acute myocardial infarction was the cause of death in 29 patients (30.2 per cent). It was the commonest primary cause of death. 25 out of the 29 patients were above the age of 60 years at time of discovery of diabetes. Acute myocardial infarction was almost twice as much in men as in women. (Table 33 in Appendix). Table 33 in Appendix shows the causes of death according to sex and duration of diabetes. 12 out of the 19 men and 9 out of the 10 women who died because of acute myocardial infarction, had diabetes for a period of less than 3 years at time of death.

12 of the 19 men were retired men, and 7 of the 10 women were "housewives". In both sexes it was common among Social Class III. Acute myocardial infarction was the primary cause of death in 5 out of 12 overweight men. None of the nine insulin-dependent patients who died did so because of acute myocardial infarction.

Other common primary causes of death were: pneumonia (17.7 per cent); neoplasm (15.6 per cent); cerebrovascular accident (14.6 per cent); and cardiac failure (6.3 per cent). It appears that cardiovascular degeneration was the cause of death in more than half of patients (cardiovascular causes including cerebrovascular accidents were the primary cause in 54 out of the 96 patients).

Similar finding was reported from Birmingham Actuarial Society Study (Malins, 1966). It was also found in that study that about 18 per cent of both men and women died as the result of acute myocardial infarction. Comparing deaths due to cardiovascular causes among diabetics with those in the same age group of the general population, a striking difference was demonstrated in the case of women aged 50-59, among whom the death rate was four times that expected in the general population; at ages 60-69 the number of deaths was still twice that expected. This supports the observation mentioned earlier that cardiovascular diseases were found among diabetic women more often than among the non-diabetic women, and that there is a decrease in the pronounced predominance of men over women found in the general population, regarding the incidence of cardiovascular diseases.

The question whether "vascular deaths" are due to the metabolic disturbance or are the result of an associated tendency to arterial diseases remains problematical. Data from Birmingham Actuarial Society Study (Table 64), shows the deaths from cardiovascular causes according to the duration of diabetes. The trend was not clean cut because the women, but not the men, showed an increased mortality the longer they had diabetes.

Table 64/

Table 64: Effect of sex on mortality (per cent actual/ expected) in diabetics due to cardiovascular causes*

Diabetes Duration (years)	Men	Women
0 - 3	148	140
4 - 8	173	199
9 and over	151	255

* Source: Malins, J.M. (1966): In: Diabetes Mellitus (editor, Duncan, L.J.P.), p.141, University Press, Edinburgh.

The University Group Diabetes Program reported an excess cardiovascular mortality amongst diabetics receiving tolbutamide or phenformin when compared to diabetics treated with diet and placebo or diet and insulin. Doubts about the methods used have led to serious criticism of the study and may have invalidated the results of this multi-centre trial. This subject has been discussed earlier. However, Lasseter, et al, (1972), from their in-vitro work, have shown that sulphonylureas (acetohexamide, chlorpropamide, tolazamide, and tolbutamide) have adverse inotropic effect on heart muscle and increase the automaticity of purkinje fibres. It has been suggested (Journal of American Medical Association, 1972), that if both these factors apply in the clinical situation they will increase the severity and extent of ischaemic myocardial damage and lead to arrhythmias.

Hadden, et al (1972), and Boyle, et al (1972), have recorded a high incidence of myocardial infarcts in patients treated with oral hypoglycaemia drugs. Most recently Soler, et al (1974), reported their findings on observing 184 known diabetics who sustained acute myocardial infarcts, and were admitted to the coronary care unit in the Birmingham General Hospital between 1967 and 1973. They reported that amongst patients on dietary carbohydrate restriction alone, the mortality was 15 per cent compared to the mortality for non-diabetics of 18 per cent, whilst the mortality for patients on oral therapy and on insulin was 40 per cent, and 37 per cent respectively. Moreover, they found that early deaths were commoner in the oral therapy group, who also had a high incidence of primary ventricular fibrillation.

An interesting finding was also reported in the last study, that is, that coronary care leads to good initial results for diabetics as for non-diabetics, the coronary care unit mortality for diabetics being 18 per cent, and for non-diabetics 14 per cent. Difference in "C.C.U." mortality was noted according to the treatment that has been used previously for control of diabetes. Whilst no deaths were recorded amongst patients on diet alone, the patients given oral therapy had a higher mortality (23 per cent) than those given insulin (18 per cent). If defibrillation had not been immediately available for the oral treatment group of patients, who had a high incidence of primary ventricular fibrillation, the mortality in this group would have been still higher. Coronary care, they concluded, has been of value for patients on oral therapy.

17 (9 men and 8 women) patients out of the 29 in our study, who died because of acute myocardial infarction, were on oral hypoglycaemic agents. However, 10 of them had a history of ischaemic heart disease before diabetes was diagnosed. Moreover, in 11 of the 17 patients, oral therapy had been used for a period of less than a year (Table 65). The 4 patients who had no history of significant diseases had an age range of 66-78 years at time of death. Thus it is obvious that no conclusion could be drawn from data on our patients regarding the association between oral hypoglycaemic drug and mortality due to myocardial infarction.

Table 65: Acute myocardial infarction deaths distributed according to type of treatment

History of Chronic Diseases	Diet alone	Oral Hypoglycaemic	
		< 1 year	1-3 years
Ischaemic heart disease	7	7	3
Arteriosclerosis, P.V.D. and hypertension	2	1	0
Arthritis and chronic bronchitis	3	0	2
No history of significant disease	0	3	1
Total	12	11	6

The death certificate

Studying the death certificates of the 96 dead patients showed that (Table 66) diabetes, or its complications, was mentioned as the primary cause of death in only 4 patients (4.2 per cent). Diabetes was recorded in the death certificate, but not as the primary cause of death in 57.3 per cent (in 18.8 per cent it was recorded as the underlying cause and in 38.5 per cent as secondary to other causes). 38.5 per cent of death certificates made no reference to either diabetes or its complications.

Table 66: Diabetes or its complications mentioned in the death certificate according to duration of diabetes from diagnosis to death

Diabetes or its complications mentioned in the death certificate	DURATION OF DIABETES from diagnosis to death							
	Males		Females		Both Sexes			
	< 2 yrs.	2+ yrs.	< 2 yrs.	2+ yrs.	< 2 yrs.		2+ yrs.	
					No.	%	No.	%
Primary cause of death	0	0	1	3	1	1.7	3	7.9
Underlying cause	7	6	2	3	9	15.5	9	23.7
Secondary to other causes	9	5	12	11	21	36.2	16	42.1
Not mentioned	12	7	15	3	27	46.6	10	26.3
Number of patients	28	18	30	20	58	100.0	38	100.0

Table 66 shows that diabetes was mentioned as the primary cause of death in one patient out of 58 who had diabetes for less than 2 years before death, but in 3 out of 38 patients who had diabetes for a duration of more than 2 years. Diabetes was mentioned but not as the primary cause of death in 65.8 per cent of certificates of those who had diabetes for more than 2 years, and in 51.7 per cent of certificates of diabetics who had the disease for less than 2 years. Diabetes was not mentioned in the death certificate of 26.3 per cent of those who had diabetes for more than 2 years, and in 46.6 per cent of those who were diabetics for a period of less than 2 years before death.

The small number of patients who had diabetes mentioned as the primary cause, was because the majority of patients were elderly patients who invariably had diseases other than diabetes at time of death, and as it has been shown in Table 63, these diseases were more important than diabetes as a leading cause of death.

Diabetes was not mentioned in higher proportions of certificates of "underweight" and "normal weight" patients compared to that of overweight. Diabetes was not mentioned in only 2 of 9 insulin-dependent, while no reference to diabetes was made in certificates of 35 out of 87 insulin-independent patients.

Certificates which made no reference to the presence of diabetes in the decreased diabetics, is shown to differ according to the duration of diabetes, and it seems that not "well established" diabetes could easily be missed by the certifying doctor.

A third factor which appears to influence diabetes recording in the death certificates of diabetics is that which concerns the form of death certificates. In 1964, the form of Scottish certification was altered to conform to the English and International form. Cameron (1966), from Edinburgh, reported that only 29 per cent of certificates of 779 diabetics who died before 1962, had diabetes mentioned as the primary cause of death. Regarding the interpretation of diabetes mortality statistics, he anticipated that the change to the English and International form will make the situation even more serious, because in England not more than 10 per cent of known diabetics who die appear in the mortality statistics as having had diabetes.

Place of death

Table 67 shows the place of death of the 96 dead patients.

Table 67: Place of death in 96 patients, according to sex and age (below and above 60 years of age)

Death occurred in:	Males		Females		Both Sexes			
	<60	60+	<60	60+	<60		60+	
					No.	%	No.	%
Hospital	5	22	6	24	11	64.7	46	58.2
Home	3	11	2	13	5	29.4	24	30.4
Institutions (Old Peoples' Homes & Nursing Homes)	0	3	1	4	1	5.9	7	8.9
Public places	0	2	0	0	0	-	2	2.5
Number of patients	8	38	9	41	17	100.0	79	100.0

57 patients died in hospital, 29 in their homes, and 8 in an institution, i.e. an old peoples' home or a nursing home. Only

slight difference was noted between the two sexes and between the two age groups (below and above 60 years of age).

8 of the 9 insulin-dependent patients died in hospital. Two men who were above the age of 60 died in public places. The cause of death in both instances was acute myocardial infarction. One patient died in the Royal Lyceum Theatre, and the other in an hotel.

P A R T IV

DIABETICS' EXPERIENCE AS PATIENTS

DIABETICS' EXPERIENCE AS PATIENTS

Diabetics and the Hospital Service

Data regarding outpatient attendances and hospital admissions were collected for patients according to year of follow-up. The year of follow-up was that of each particular patient in relation to time of first attendance. For example, the first year admissions and duration of stay in hospital for a patient who started to attend the clinic in July 1969, was from that date to July 1970. His second year was from July 1970 to July 1971, and his third year was from July 1971 to July 1972. Because the observation period ended at 31.12.72, the experience of the patient in the above example was ascertained for 3 years only. In this way information about attendances at the clinic and hospital admissions were obtained for a period of: 3 years for patients who first attended in 1969; 2 years for those who attended in 1970; and 1 year for those who attended in 1971.

Information for one year following diagnosis is related to all 662 newly diagnosed patients (diagnosed in 1969, 1970 and 1971). Information for the second year is related to patients who were first diagnosed in 1969 and 1970 (387 patients), while that for the third year is related to patients first diagnosed in 1969 only (167 patients). The number of patients mentioned above does not correspond exactly to the number of patients diagnosed in these particular years. Defaulted patients were excluded and so were patients who died.

However, dead patients were excluded only after death had occurred, and in their case part of a year was considered as a complete year of follow-up. For example, in the case of a patient diagnosed diabetic in April 1970, who died in January 1971, his attendances and admissions were assumed to be for one complete year instead of his actual 9 months of follow-up.

103 patients "with duration" were also studied regarding their attendances at the clinic and hospital admissions according to year of follow-up. But since their number is small, and becomes still smaller in each successive year of follow-up (58 in second year and only 26 in the third year), only occasional mention will be made regarding them in the following pages.

Information regarding outpatient attendances refers to attendances made by patients to the outpatient clinics of the Diabetic and Dietetic Department of the Royal Infirmary. Admission to hospital and duration of stay refers to patients admitted to all hospitals, except those who were admitted to hospitals and units for mental illness, mental defect and maternity.

Causes of admissions and duration of stay were coded as they appeared on the hospital discharge letters, inpatient records, summary sheet - S.M.R.1, and on the hospital inpatient statistical return made available to the hospital authorities by the Scottish Home and Health Department.

Hospital period was calculated in days, and hospital day is defined as a day on which a person is confined to a hospital as an inpatients for one night or more.

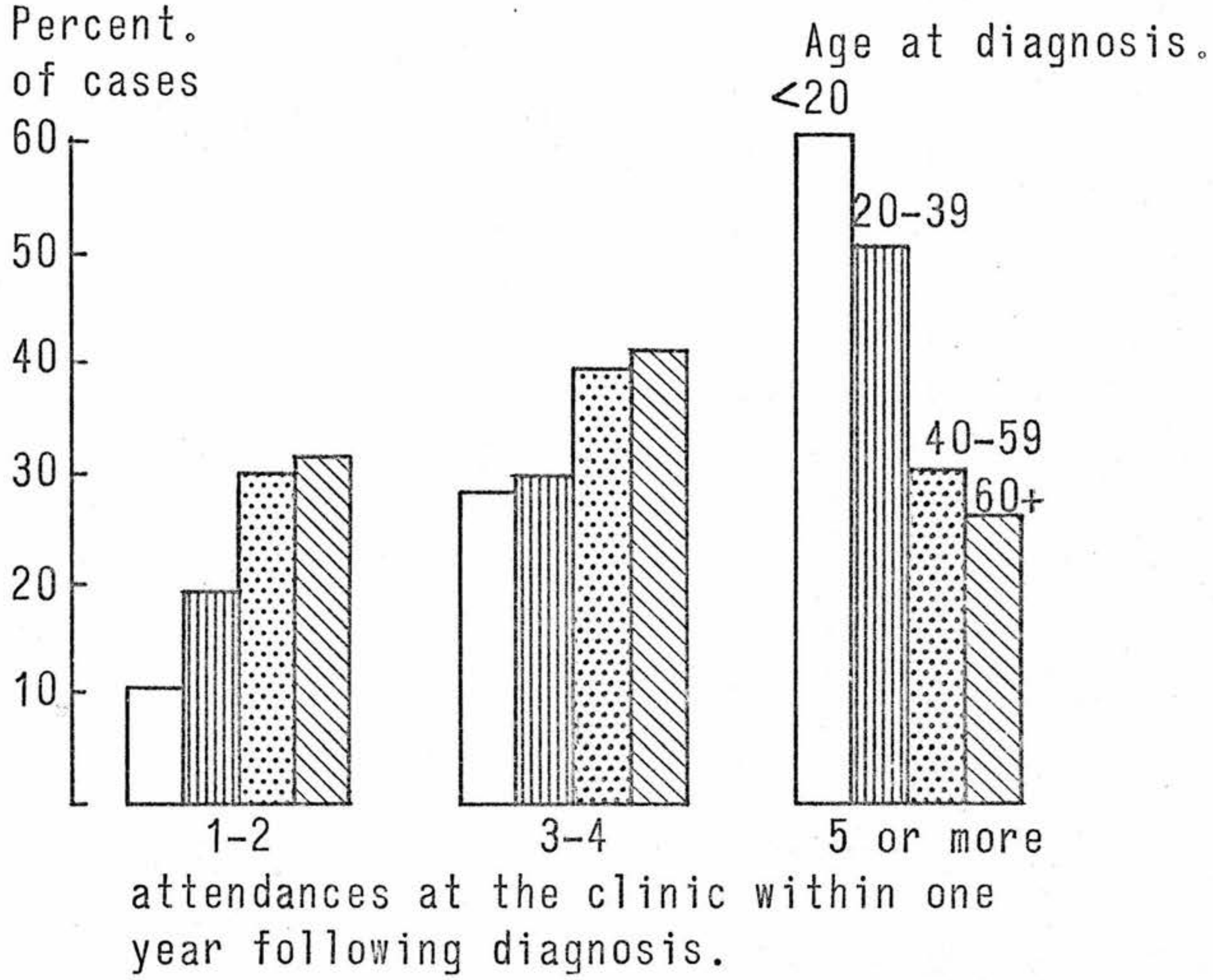
Outpatient attendances: Table 68 shows the percentage of patients in each age group according to the number of attendances at the clinic within one year of diagnosis.

Table 68: Number (per cent) of 662 newly diagnosed patients distributed according to number of attendances in the first year, by sex.

Age at diagnosis	Number of Attendances 1-2	3-4	5+	Total Per cent	Total Number
	MALES				
< 20	9.5	33.3	57.2	100.0	21
20-39	19.2	30.8	50.0	100.0	26
40-59	33.7	35.9	30.4	100.0	92
60-79	36.1	39.6	24.3	100.0	144
80+	30.0	60.0	10.0	100.0	10
Total	32.8	37.5	29.7	100.0	293
	FEMALES				
< 20	13.3	20.0	66.7	100.0	15
20-39	19.1	28.6	52.4	100.1	21
40-59	26.3	42.4	31.3	100.0	99
60-79	27.8	42.1	30.1	100.0	216
80+	50.0	38.9	11.1	100.0	18
Total	28.1	40.0	31.9	100.0	369

Figure 12.

Age distribution of patients according to number of attendances at clinic;(both sexes; 662 patients)



For all ages, both in the case of men and women, the most frequent number of attendances was 3-4 times a year. This was more pronounced in the case of women where 40 per cent of the 369 newly diagnosed females attended 3-4 times. A higher proportion of women than men attended 5 times or more. The reverse is the case when 1-2 attendances is considered.

Younger patients attended the clinic much more frequently than did the old. 57.2 per cent and 66.7 per cent of males and females respectively below the age of 20 attended five times or more, while 24.3 per cent and 30.1 per cent of men and women respectively, in the age group 60-79, attended five times or more. Only 10 per cent of patients aged above 80 years attended a similar number of times.

Figure 12 shows that in both sexes the number of patients who attended 1-2 times in the first year increased progressively with increasing age. A similar pattern is seen regarding 3-4 times attendance, while in the case of attendances of 5 times or more, the situation is reversed, where 61.1 per cent of patients below the age of 20 years is compared with 26.6 per cent of those above the age of 60 years.

In the second and third year following diagnosis, the frequency of attendances declines for all ages and in both sexes (Tables 34 and 35 in Appendix). In the second year, 60.9 per cent of men and 55.2 per cent of women attended 1-2 times. The corresponding figures in the third year were 73.5 per cent and 65.5 per cent of men and women respectively.

In the second year only 25 per cent of males and 28.6 per cent of females below the age of 20 attended the clinic 5 times or more. The proportion of patients with frequent attendances decreased progressively with the increase of patients' age. Only 4.2 per cent of men and 4.4 per cent of women in the age group 60-79 attended 5 times or more in the second year. A similar picture was noted with third year attendances.

18.5 per cent out of 184 men and 16.8 per cent out of 203 women for whom data for second year attendances were available, did not attend the clinic in the second year. 12.1 per cent out of 83 men and 13.1 per cent out of 84 women did not attend the clinic in the third year of follow-up. Failure to attend during the second and third years was more noticeable among the old patients rather than the young.

The frequent attendances of younger patients was mainly due to the fact that, being insulin-dependent, the control of the diabetic state of these patients needed frequent review. The insulin dosage and dietary regulation, and the whole subject of the principle of self-regulation were discussed with the patient on each visit to ensure an adequate level of learning. They were advised to report to the clinic every 1-2 months in the first 6 months after diagnosis, and if their diabetes control was thought to be adequate they were advised to report to the clinic twice or three times yearly. Needless to say, if the need arises, every diabetic patient (not only the insulin-dependent) can report to the clinic without previous appointment.

The Diabetic Department also provides the service of a waiting registrar to deal with emergencies after the official hours.

Maturity onset diabetics who rarely needed insulin to regulate their diabetes, and whose hyperglycaemia was adequately controlled by simple dietary restriction, or by hyperglycaemic agent, were given appointments to come to the clinic once in every 8-12 months. However, these patients at the beginning of their illness needed greater vigilance and therefore attended the clinic more frequently. As has already been discussed in Part III of this thesis, the therapy of some of these patients needed to be changed. This took place usually at the beginning of their illness, which meant more frequent attendances in the first year of follow-up. They were given an appointment to come back in about 1 month to 6 weeks after their first visit, when their diabetes was reviewed, and any change of treatment thought necessary was then introduced. Some of the middle-aged and elderly patients who were controlled on diet or diet and oral agent, and later were shown to need insulin injections to maintain adequate control, were educated in the principle of insulin-self-regulation on an outpatient basis. The patient reported daily for about a week or 10 days, until the team of doctor, nurse and dietitian were satisfied that he or she had grasped the principle of insulin usage. The number, age and sex distribution of such patients will be discussed shortly, but the point to be made here is that the high number of attendances made by these patients influenced the overall number of attendances made by patients in the middle and older age groups.

The frequency distribution curve of the number of attendances is skewed to the right, in that the mean number of attendances is higher than the median. In other words, the mean which is effected by the number of attendances of the few patients who attended for a greater number of times is thus shifted to the right of the median (or the middle) of these attendances.

Table 69: Mean and median number of attendances according to the year of follow-up. ("No duration" and "Duration" patients).

Year of follow-up	Males		Females		Total Number of patients
	Mean	Median	Mean	Median	
	"NO DURATION"				
First Year	3.8	2.9	3.8	3.1	662
Second Year	1.7	0.7	1.9	1.1	387
Third Year	1.7	0.9	1.8	0.8	167
	"DURATION"				
First Year	3.5	2.7	3.3	2.5	103
Second Year	1.7	0.9	2.2	1.4	58
Third Year	1.8	1.2	1.8	1.0	26

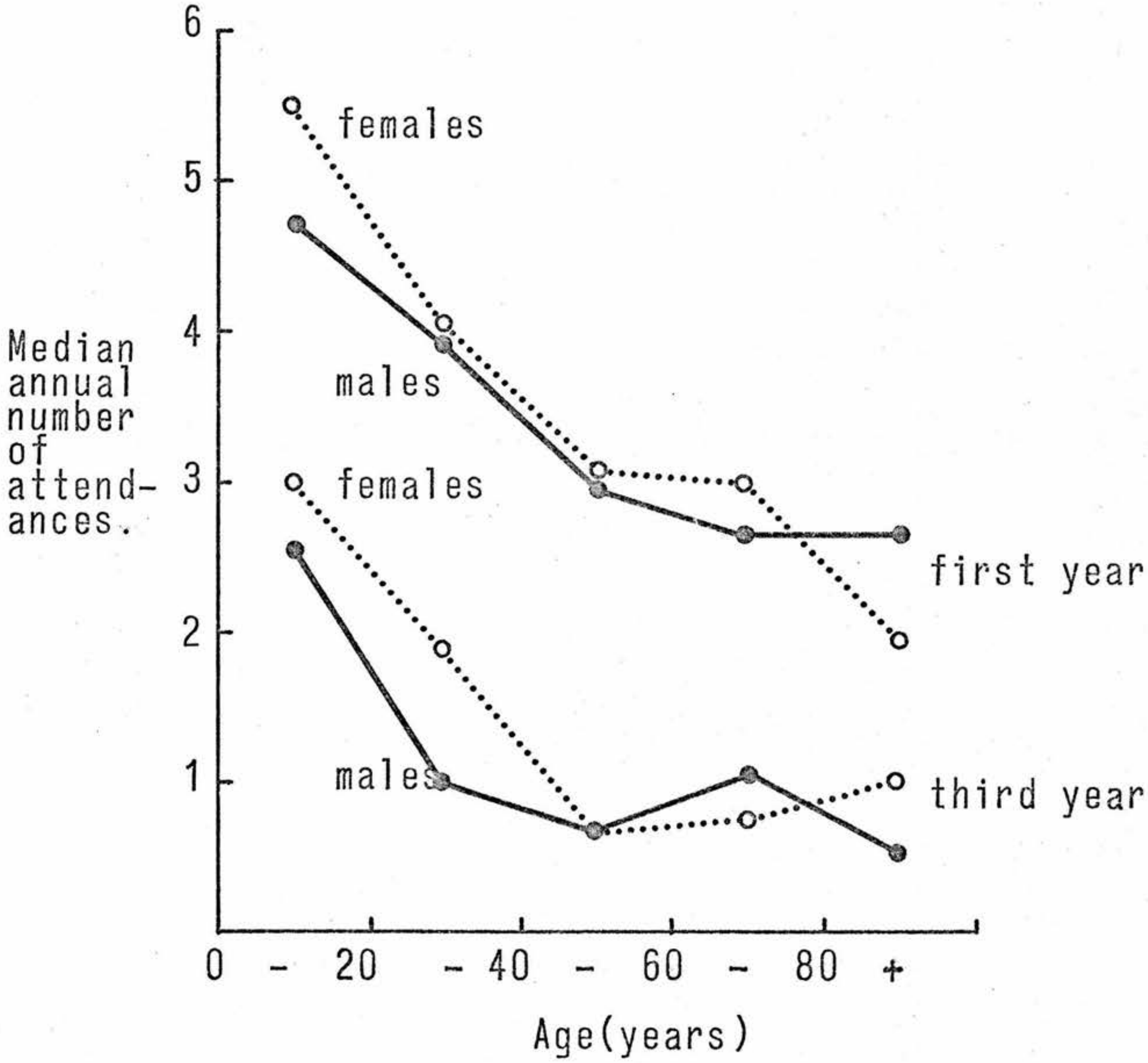
Table 69 shows the mean and median number of attendances for both "Duration and "No duration" groups of patients, and for the 3 years of follow-up. In both men and women there was a marked reduction in the mean as well as in the median number of attendances in the second and third year compared with those in the first year. There was only a slight difference between the two groups of patients regarding the mean and median number of attendances in the first year. The general pattern of decline in the number of attendances in the second and third year of follow-up is also seen equally in the "Duration" and "No duration" patients. Among the "No duration" group the modal number of attendances in the first year was three times and four times for men and women respectively. For the "Duration" patients it was three times in both men and women. Among the "No duration" group the mode decreases in the following years to be one attendance for both men and women in both the second and third year of follow-up.

The "Duration" group of patients have been shown to contain a higher proportion of young diabetics than the "No duration" group. This is reflected in the number of attendances made by this group. The effect of this factor is seen again in the number of attendances in the second and third year, where the mean and median number of attendances were higher among the "Duration" than among the "No duration" group. This is true for both men and women.

To demonstrate once more the effect of age on the number of attendances, the median, which is more appropriate measure of position in this case, was calculated for both men and women

Figure 13.

Newly diagnosed diabetics.
Age and annual out-patient attendances -
first and third years following diagnosis.



for the "No duration" group according to year of follow-up for the five age groups (Table 70).

Table 70: Number (median) of attendances at the clinic according to year of follow-up and age at diagnosis ("No duration" patients)

Age at diagnosis	First Year		Second Year		Third Year	
	Males	Females	Males	Females	Males	Females
< 20	4.7	5.4	2.0	3.0	2.5	3.0
20-39	3.9	4.0	1.0	1.8	0.9	1.8
40-59	2.9	3.1	0.7	0.6	0.7	0.7
60-79	2.7	3.0	0.7	1.2	1.1	0.8
80+	2.7	1.9	0.5	0.7	0.5	1.0
All ages	2.9	3.1	0.7	1.1	0.9	0.8
No. of patients	293	369	184	203	83	84

Patients below the age of 20 maintained a higher number of attendances in the second and third year. The median number of attendances in the first year was 4.7 and 5.4 for males and females respectively. In the third year it was 2.5 for males and 3.0 for females. In the other four age groups the decrease in the second and third year was much more pronounced. For those in the age group 60-79 the median number of attendances decreased from being 2.7 and 3.0 in the first year, to 1.1 and 0.8 in the third year for men and women respectively.

Figure 13 shows the trend of median number of attendances in the first year and third year for men and women according to age. It appears that median number of outpatient visits per patient decreases progressively with age in both the first and third year. This is more pronounced in the first year and more in women than in men.

Many authors have commented that in the general population there is low usage of outpatient services by the elderly (Scott & Gilmore, 1966; Backett, et al, 1966; Forsyth & Logan, 1968).

Forsyth and Logan reported that: "The elderly are represented in the outpatient population at no higher rate than they are represented in the general population." This confirms the finding by Scott and Gilmore in Edinburgh, and Backett, et al, in Aberdeen. Nevertheless, Gruer (1972), in her Scottish Border studies has criticised these findings. She has shown that "The elderly are highly represented in the use of outpatient services as a whole."

These authors have studied outpatient referrals to all specialties, and it is difficult to decide how much of their findings apply to the case of diabetic clinics. Scott and Gilmore have shown that surgical outpatient departments have by far the largest share of all new outpatient referrals to all Edinburgh outpatient departments.

New outpatients referred to the Diabetic and Dietetic Department were only 1.9 (289) per cent of the total referrals of 15,357 new outpatients studied. The surgical group of conditions, namely: General Surgery, Orthopaedics, Ear, Nose and Throat, and Gynaecology accounted for almost half (49.3 per cent) of all referrals. This will undoubtedly result in a relatively higher proportion of those in the age group 45-60 being referred to hospital, while the very young and the very old will be relatively unrepresented in the hospital outpatient population. Gruer, who said: "The age distribution of new outpatients to a large extent resembles that of discharges and deaths from inpatient care", has excluded casualty, radiology, psychiatry and antenatal outpatient referrals from her calculations on the outpatients. Moreover, it is noticed from the report that outpatient consultations, including physiotherapy, were used more by the elderly than when physiotherapy was excluded. This suggests that the outpatient referrals to hospital are governed mostly by the need of the patient.

Although it is true, as Scott and Gilmore pointed out, that age and sex exert a selective action in determining referral to hospital, the referral of diabetics to diabetic clinics is influenced more by the degree of need of the particular patient. The young insulin-dependent diabetics need to be referred to the special diabetic clinic to be educated in insulin self-regulation, and in the principle of dietary regulation.

The elderly patients present themselves to the general practitioners with other diseases as well as diabetes, and tend to be referred more readily to hospital. Some of the elderly diabetics with complete Islet cell exhaustion need insulin to prevent the development of ketoacidosis. These patients would be referred to the clinic for management more readily than the rest of the elderly diabetics, who are treated by diet or by diet and oral drugs. Indeed, as has been discussed in Part II of this thesis, we believe that almost all newly diagnosed diabetics are referred to hospital at the start of their illness to receive the specialist advice on management.

The frequency of attendance after first attendance is similarly affected by the type of diabetes and the need for closer supervision. Young diabetics attend more frequently than those in the middle and old age groups. This because the young need frequent insulin-dose adjustments and medical examination to detect early signs of diabetic complications, which are seen more commonly among them than among the elderly diabetics. Moreover, the fact that among the elderly, diabetes is associated with other diseases, those patients also tend to attend other hospital departments, and consequently the frequency of their attendances to the diabetic one is reduced. For example, some elderly patients were attending the Rheumatology Department in the Northern General Hospital for their arthritis, and the physician there also watched their diabetes control and kept the Diabetic Department informed about their progress.

The median number of attendances per diabetic in the first year for those below 20 years, is 5 times (for both sexes); for those in the age group 60-79 it is 2.9; and for patients above 80 years it is 2.2. Because the majority of diabetics are middle-aged and elderly, the overall median number of attendances for all ages is 3.0 times, which is nearer to that of these age groups. In the second year the overall median number of attendances per diabetic is 0.9, while for those below 20 years it is 2.4. In the third year the number of attendances for all ages is 0.8, while for those below 20 it is 2.6 times.

Table 71 illustrates the effect of type of diabetes on the frequency of attendances in the first year following diagnosis.

Table 71: Number (per cent) of insulin-dependent and insulin-independent patients distributed according to number of attendances

Number of attendances	Males		Females	
	Insulin-dependent	Insulin-independent	Insulin-dependent	Insulin-independent
1-2	10.4	36.7	12.5	29.5
3+	89.6	63.3	87.5	70.5
Number of patients	100.0 (48)	100.0 (245)	100.0 (329)	100.0(40)

89.6 per cent and 87.5 per cent of insulin-dependent men and women respectively attended three times or more, while 63.3 per cent and 70.5 per cent of insulin-independent men and women respectively attended for three times or more.

The "Inpatients" group who were referred to the diabetic clinic while in hospital, are shown to have less frequent attendances than the other two groups of referrals, the "Outpatients" and "G.T.T." (Table 72).

Table 72/

Table 72: Number (per cent) of 662 patients in each "source of referral" group according to number of attendances

Number of attendances	"Outpatients"	"Inpatients"	"G.T.T."
	MALES		
1-2	28.5	47.4	35.5
3+	71.5	52.6	64.5
Number of patients	100.0 (193)	100.0 (38)	100.0 (62)
	FEMALES		
1-2	25.2	40.8	28.6
3+	74.8	59.2	71.4
Number of patients	100.0 (266)	100.0 (54)	100.0 (49)

52.6 per cent of men and 59.2 per cent of women in the "Inpatient" group attended 3 times or more, while the corresponding figures for the "Outpatient" group are 71.5 per cent and 74.8 per cent for men and women respectively. The figures for the "G.T.T." group are 64.5 per cent and 71.4 per cent for men and women respectively.

The inpatients were shown to suffer from other diseases more than the other two groups of patients. The number of those who died was proportionally higher among the inpatients than among the outpatients or the G.T.T. patients. These two factors might be the main reasons for the relatively smaller number of inpatients who attended the clinic more frequently (for 3 or more times).

Table 73 shows that patients who attended 1-2 times more were seen more among the dead than among the survival patients.

Table 73/

Table 73: Number (per cent) of survival and dead patients distributed according to number of attendances

Number of attendances	MALES		FEMALES	
	Alive	Dead	Alive	Dead
1-2	31.0	41.5	27.4	32.5
3+	69.0	58.5	72.6	67.5
Number of patients	100.0 (252)	100.0 (41)	100.0 (329)	100.0(40)

41.5 per cent of men and 32.5 per cent of women who died attended for 1-2 times in the first year, while the majority of those who remained alive attended 3 times or more, with only 31.0 per cent of men and 27.4 per cent of women attending 1-2 times. The number of dead patients was small, hence the proportion of those who attended three times or more is affected to a great extent by the number of patients who died early in their first year and therefore did not have the chance of completing a year's experience.

When the occupation and marital status of patients were examined in relation to number of attendances at the clinic, there was no clear difference either between the economically active and inactive patients, or between the married persons on the one hand and "other" marital status on the other (Tables 36 and 37 in Appendix).

Hospital admission and duration of stay

The number of newly diagnosed diabetics admitted to hospital within one year following diagnosis is shown in Table 74.

Table 74: Number of patients admitted to hospital within one year following diagnosis according to age and sex (662 newly diagnosed patients)

Age at diagnosis	MALES					FEMALES				
	Number of admissions					Number of admissions				
	Nil	1	2	3+	Total No.of P'ients	Nil	1	2	3+	Total No.of P'ients
< 20	1	17	3	0	21	2	11	2	0	15
20-39	8	16	2	0	26	6	15	0	0	21
40-59	67	25	0	0	92	66	29	3	1	99
60-79	86	46	10	2	144	117	81	16	2	216
80+	5	5	0	0	10	12	5	1	0	18
All ages	167	109	15	2	293	203	141	22	3	369
Per cent	57.0	37.2	5.1	0.7	100.0	55.0	38.2	6.0	0.8	100.0

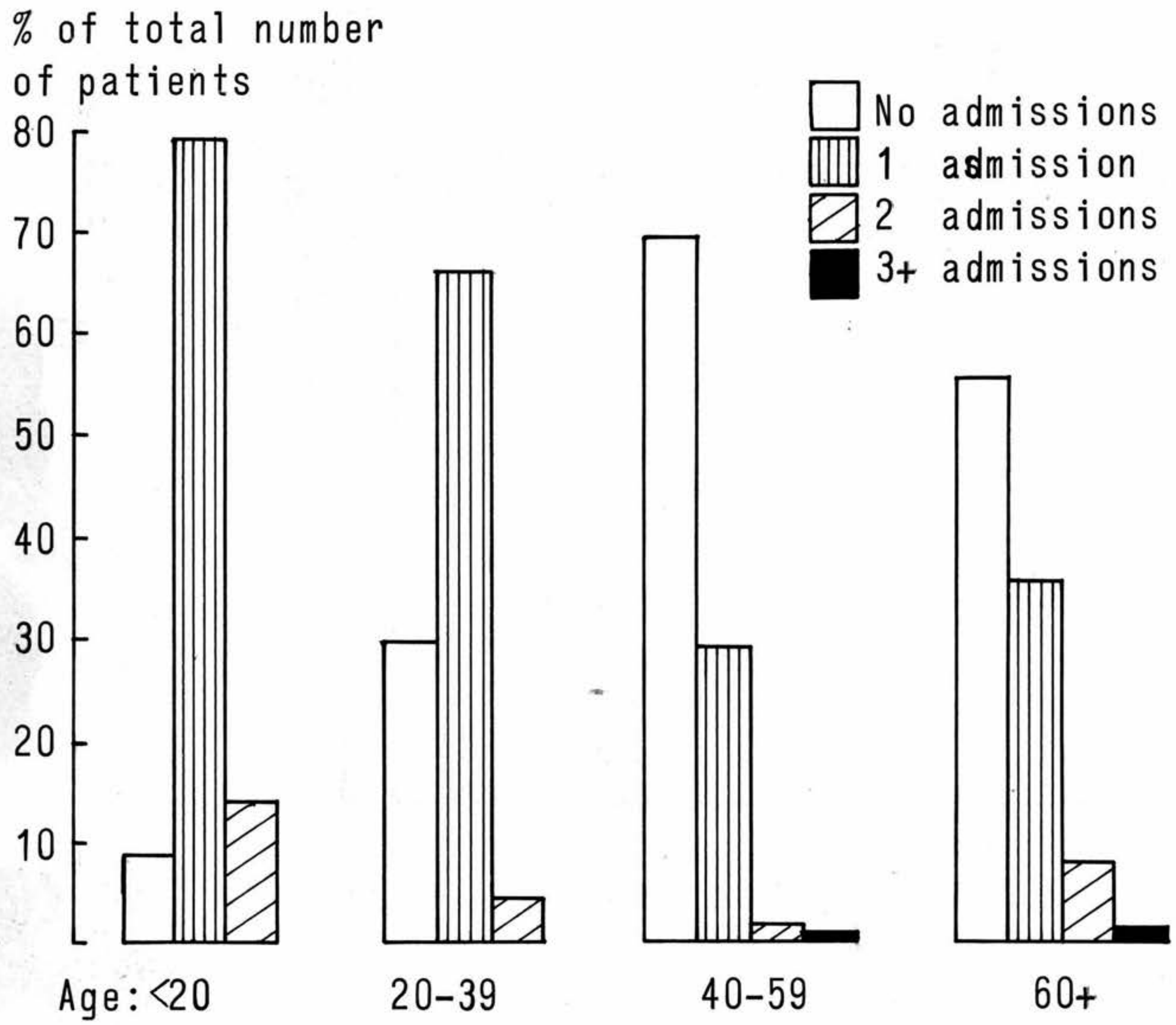
43.0 per cent and 45.0 per cent of newly diagnosed men and women respectively were admitted during the first year.

Among the "Duration" group a similar proportion were admitted to hospital in the first year following their first attendance. 43.1 per cent of men and 38.5 per cent of women had one or more admission (Table 38 in Appendix).

37.2 per cent and 38.2 per cent of newly diagnosed men and women respectively were admitted for one time in the first year. The proportion decreases when two admissions (5.1 per cent of men and 6.0 per cent of women) and three admissions or more (0.7 per cent of men and 0.8 per cent of women) are considered.

Figure 14.

Age and admissions within one year following diagnosis. (662 patients)



A similar pattern was noted among the "Duration" group.

91.7 per cent of those below the age of 20 were admitted to hospital in the first year, while only 30.4 per cent and 43.6 per cent of those in the age group 40-59 and 60-79 respectively, were admitted in the first year. 5 out of 10 men in the age group above 80, and 6 out of 18 women in the same age group were admitted to hospital. The number of hospital admissions also varied according to the age of the patient and is shown graphically in figure 14.

In all age groups the usual number of admissions was for one time. However, admission once only was commoner among the young diabetics than among those of the middle ages (40-59), among whom the number of admissions was also less than that among the older patients (above 60).

28.3 per cent of patients in the age group 40-59, who had one admission in the first year, are compared with 35.3 per cent of those above the age of 60 years. Admission on two occasions showed a similar U-shaped pattern with age. Those admitted to hospital twice in the first year were: 13.9 per cent of patients below 20 years of age; 4.2 per cent of patients in the age group 20-39; 1.6 per cent of those in the age group 40-59; and 7.0 per cent of those above the age of 60 years.

Fewer patients were admitted for 3 or more times. One out of 191 patients in age group 40-59 and 4 patients out of 360 patients in the age group 60-79 were admitted 3 times or more.

In the second year and third year following diagnosis (Table 39 in Appendix), there was a sharp reduction in patients' admission to hospital. Only 13.5 per cent of the 387 second year patients were admitted to hospital, and in 12.2 per cent, once only. In the third year only 15.0 per cent of the 167 patients had hospital admission, and this time 13.8 per cent had one admission.

The high admission rate which the young diabetic showed in the first year was reduced considerably in the second and third year. In the second year only 3 out of the 19 who were below 20 years of age had admission. Patients who were admitted three times or more in the second year numbered only 2, and none in the third year. A 14-year old girl with port-wine haemangiomata on her face was admitted three times to Bangour Hospital in her second year for cosmetic operations.

The main cause for the high rate of hospital admissions in the first year among young patients was the education in self-regulation which took place at the start of their illness. This is clearly manifested by the marked drop in the proportion of young patients who were admitted in the second and third year. Indeed, in the first year, for patients below the age of 20, diabetes was the principal cause of admission in 17 out of the 20 males, and in 12 out of the 13 females. In the second and third year following diagnosis the admission among the young did not differ from that among other age groups. Table 75 shows the percentage of patients in each age group who had no hospital admission, according to the year of follow up.

Table 75/

Table 75: Per cent of diabetics in each age group who had no hospital admission according to year of follow up (both sexes)

Age	First Year	Second Year	Third Year
	Per Cent		
All ages	55.9	86.6	85.0
< 20	8.3	84.2	71.4
20-39	29.8	81.8	75.0
40-59	69.6	86.2	87.8
60-79	56.4	88.0	86.5
80+	60.7	83.3	85.7

There is a marked increase in the number of young patients below 20 years of age who were not admitted to hospital in the second and third year. This difference is also noted to a lesser extent in the other age groups, being less marked among patients of the age group 40-59. This is mainly due to the fact that a high proportion (about 70 per cent) of patients in this age group did not have admission in the first year, while in the second and third year the proportion was not much different from that of the other age groups.

Here again the medical need rather than the age has more influence on the trend of admissions to hospital. More than 90 per cent of patients below 20 years of age, and more than 70 per cent of patients in the age group 20-39 were admitted to hospital in the first year. Patients in the age group 40-59 had less admission than the older age groups.

Education in insulin self-regulation was the cause of the high admission among the young patients, while other disease conditions (cardiovascular and other chronic conditions) were the cause of admission among those above the age of 60 years. Middle-aged patients (40-59 years) on the other hand, had the lowest admission rate, because among them the insulin-dependent patients are few, and the frequency of chronic diseases is less common.

Table 76 shows the number (97), age and sex distribution of patients who needed the education in insulin self-regulation, according to whether they were seen as inpatient or outpatient. All the 90 insulin-dependent newly diagnosed patients needed such education. 7 out of the 50 insulin-dependent from the "Duration" group who needed similar management are shown in the same table.

Table 76: Education in insulin self-regulation as inpatient or as outpatient according to sex and age at diagnosis (1969-1971 period). Numbers in parentheses are patients from duration group.

Age at diagnosis	MALES			FEMALES		
	Inpatients	Outpatients	Total	Inpatients	Outpatients	Total
< 20	21 (1)	1	22	12	1	13
20-39	17 (1)	2	19	11	2	13
40-59	2 (1)	7 (1)	9	7 (1)	3 (1)	10
60-79	1	1	2	6	2	8
80+	0	1 (1)	1	0	0	0
Total	41	12	53	36	8	44
Per cent	77.4	22.6	100.0	81.8	18.2	100.0

77.4 per cent of the 53 males and 81.8 per cent of the 44 females who were educated in insulin self-management were admitted to hospital for that purpose. In none of the 77 patients so admitted was the sole cause education only. There was always a second cause for admission, as, for example, diabetic coma or impending coma, urinary tract infection or other incurrent infections. Almost all young patients were admitted to hospital for the purpose of teaching, while in the middle age group - 40-59 - there is a difference between men and women. 7 out of the 9 men were educated as an outpatient, while only 3 out of the 10 women had their education in the outpatient department. Education in hospital was similarly carried out for 6 out of the 8 women in the age group above 60 years.

Middle-aged patients in general preferred to be taught as outpatients because of their daily life commitments. In many cases the patient's choice was considered and the decision was taken after full understanding of the physical, mental and social status of each particular patient.

Duration of stay in hospital

The mean duration of stay per diabetic admitted in their first year is 19.7 and 21.7 days for men and women respectively. This was calculated for diabetics admitted per year (based on 292 newly diagnosed diabetics who were admitted in the first year). The median in this case is also lower than the mean and it was

13.3 days for men and 16.8 days for women.

Table 77 shows the number of patients admitted and mean duration of stay in hospital per patient per year for patients of our study compared with that experienced by all patients discharged from hospitals in Scotland in 1970*.

Table 77: Number of patients and mean duration of stay in days per diabetic discharged (patient of present study, first year experience) compared with that of all discharges from hospital, Scotland, 1970.

AGE	MALES		FEMALES	
	Number of patients with admission	Duration of stay in days	Number of patients with admission	Duration of stay in days
	Newly diagnosed diabetics of present study			
< 20	20	13.4	13	12.6
20-39	18	10.9	15	12.8
40-59	25	15.7	33	20.8
60-79	58	25.7	99	24.1
80+	5	27.2	6	30.7
All ages	126	19.7	166	21.7
	General population, Scotland, 1970**			
15-24		10		8
25-44		12		10
45-64		17		18
65-74		25		32
75+		41		62
All ages		17		20

** See foot of next page

*This year, 1970, was chosen as it is the middle year in our study (1969-71).

The two sets of data are not exactly comparable, partly because the grouping of ages is different and partly because our data refer to duration per patient admitted (discharged), while those of the general population are based on case discharges. (Case discharges are based on successive terminations of stay). However, it is worth while to see how they do compare.

For all ages duration of stay in hospital was slightly longer for diabetics than for the general population, especially among women. Diabetic women stayed in hospital 20 days on average, while the period of hospitalisation for women of the general population was 17 days. Young diabetics appear to have a slightly longer period of hospitalisation than those of comparable ages of the general population. The reverse is true when older age groups are considered, especially among women. The duration of stay for diabetic women above the age of 80 years was 31 days, while women of the general population above the age of 75 had a duration of 62 days per year. This discrepancy might be due to the smaller number of diabetics (5 men and 6 women) in age group above 80 years. However, it appears that diabetics in the first year following diagnosis, experience no longer period of hospitalisation than that experienced by the general population. Older diabetics do not stay as long as their counterparts of the general population.

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* (footnote relating to Table 77 on previous page): Scottish Hospital In-Patients Statistics, 1970, Table 2A, p.5, Total Discharges from Hospitals, Scotland, Scottish Home and Health Department, Edinburgh, 1972

Indeed, relating the period of hospitalisation to the total number of patients in each particular age group shows that duration of stay per diabetic per year among the elderly patients is only slightly higher than that for other age groups (Table 78).

Table 78: Total number of patients and mean duration of stay per year per diabetic.

AGE	MALES		FEMALES	
	Total No. of patients	Duration of stay per diabetic per year	Total No. of patients	Duration of stay per diabetic per year
< 20	21	12.8	15	10.9
20-39	26	7.5	21	9.1
40-59	92	4.3	99	6.9
60-79	144	10.5	216	11.0
80+	10	13.6	18	10.2
All ages	293	8.4	369	9.8

As 55.9 per cent of newly diagnosed patients had no hospital admission in the first year, the mean duration per diabetic per year would be lower than that calculated per diabetic admitted. For all ages it was reduced from 19.7 to 8.4 for men and from 21.7 to 9.8 for women. As the majority of young patients were admitted to hospital, the duration of stay per diabetic in the younger age groups, especially those below the age of 20, was affected only to a little extent. While in the ages above 40,

Table 79: Number of patients admitted within first year, according to the principal cause of admission, showing bed days and mean duration of stay per diabetic admitted.

AGE	MALES						
	All causes	Diabetes and its complications	Cardio-vascular including C.V.A.	Respiratory diseases	Cataract	Neoplasms	Others
< 20	20	17	0	0	0	0	3
20 - 39	18	12	0	0	0	0	6
40 - 59	25	3	9	5	1	0	7
60 - 79	58	10	17	8	5	8	10
80+	5	1	0	2	0	2	0
Number of patients	126	43	26	15	6	10	26
per cent	100.0	34.2	20.6	11.9	4.8	7.9	20.6
bed-days	2482	722	837	294	92	280	257
Mean Duration of stay (per diabetic admitted)	19.7	16.8	32.2	19.6	15.4	28.0	9.9
AGE	FEMALES						
< 20	13	12	0	0	0	0	1
20 - 39	15	10	0	0	0	1	4
40 - 59	33	7	4	6	1	1	14
60 - 79	99	18	35	6	8	8	24
80+	6	1	2	0	3	0	0
Number of patients	166	48	41	12	12	10	43
per cent	100.0	28.9	24.8	7.2	7.2	6.0	25.9
bed days	3602	840	947	227	328	364	897
Mean duration of stay (per diabetic admitted)	21.7	17.5	23.1	18.9	27.3	36.4	20.9

there was a marked decrease in the period of hospitalisation when calculated for all patients in these particular age groups. Patients of the age group 40-59 showed the shortest period of hospitalisation per patient per year. For patients above 80 years of age, duration was reduced from 27.2 to 13.6 for men and from 30.7 to 10.2 for women.

In the second and third year following diagnosis the duration of stay in hospital was similarly reduced when considering the total number of patients instead of calculating it for patients admitted only (Tables 40 and 41 in Appendix). However, the number of patients admitted in these years was too small to allow comments. For example, below the age of 20, two patients were admitted in the second year and one patient in the third year.

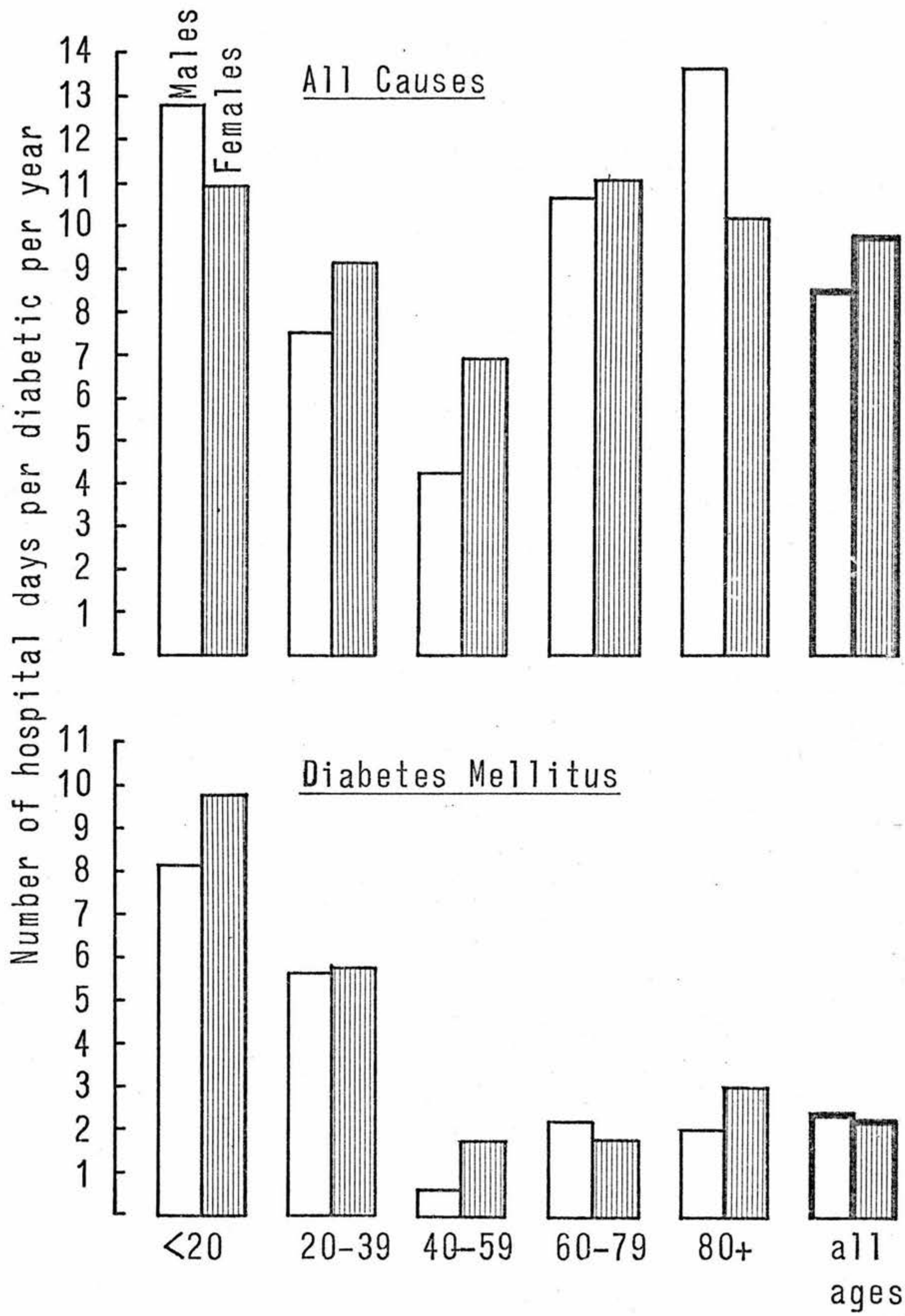
Causes of admission to hospital

Admission to hospital due to diabetes was recorded only in 34.2 per cent of 126 men and 28.9 per cent of 166 women admitted during the first year (Table 79). Although diabetics had a longer period of hospitalisation than the general population, relatively little of it was attributed to diabetes. Hospital days due to diabetes accounted for 29.1 per cent and 23.3 per cent of the hospital days from all conditions in men and women respectively.

The principal cause for admission in the large majority of young patients was diabetes mellitus, while among patients of middle and old ages it was cardiovascular diseases, including cerebrovascular accidents. Chronic diseases like cataract and

Figure 15.

Number of hospital-days due to all causes and to diabetes, per diabetic per year.



neoplasms predominated among those who were above 60 years of age.

When the cause of admission was diabetes the mean duration of stay per diabetic admitted was shorter than that for most of the diseases listed. In Figure 15 the comparison is shown between length of stay where the principal cause was diabetes, and that where the admission was due to all causes. The difference between the two is manifested clearly among patients of middle and old age.

Among men, duration in hospital due to cardiovascular causes was the longest, with that due to neoplasms coming next. In women the longest mean duration was for neoplasms (34.4), and cataract (27.3).

Comparing the duration in hospital for some of these causes among diabetics, with that for similar diseases among the general population (Table 2B, South Eastern Region - Scotland, In-Patient Statistics, S.H.H.D., 1970), shows some interesting findings. The period of hospitalisation for heart diseases among men of the general population was 20 days, while for our patients with cardiovascular diseases it was 32.2 days. Among women of the general population the duration, because of cataract, was 14 days. In diabetic women of our study the duration of cataract was 27.3 days. If this suggests anything it means that in diabetics suffering from chronic diseases like neoplasms, cataract and cardiovascular diseases, diabetes tends to increase their period of hospitalisation. Perhaps by making the physicians more apprehensive about complications that might develop on their discharge from hospital.

Our data are for those newly diagnosed diabetics and cannot be compared with all diabetic discharges from hospital. Moreover, the admission rate and duration of stay depend to a large extent on the policy of the practising physician in each particular hospital.

The mean duration of stay for diabetics noticed in the Scottish Hospital In-Patient Statistics (1969-72) varied from one year to another and from one region to another in each particular year (Table 80).

Table 80: Mean duration of stay per case discharged per year, Scotland, according to the five Scottish Hospital Regions for the years 1969-72*

Hospital Region	MEAN DURATION OF STAY IN HOSPITAL							
	1969		1970		1971		1972	
	Males	Females	Males	Females	Males	Females	Males	Females
North	23	57	19	54	18	25	22	20
North-East	20	39	24	47	42	21	27	22
Eastern	20	33	18	27	14	29	19	39
South-Eastern	19	28	25	29	27	24	18	27
Western	19	28	23	28	19	29	20	28

* Scottish Hospital In-Patient Statistics, Table 2B, p.17, for the years 1969, 1970, 1971 and 1972

The overall picture suggests that diabetic admission to hospital and the duration of stay is affected by the beliefs of each consultant, and the more stable regimes which are adopted by the Western and South-Eastern regions. However, the mean duration quoted in Table 80 is higher than that seen in our patient. This is partly due to the fact that the patients' experience in our study was that of the first year after diagnosis, and it may well be that the majority of diabetics (maturity onset diabetics) are admitted more in the later years.

Nearly all the young insulin-dependent diabetics were admitted to hospital following diagnosis while only a smaller proportion of the middle-aged and elderly were admitted to hospital, and in the majority of them the cause of admission was for diseases other than diabetes. Moreover, it was shown that the length of stay in hospital was different in the two groups. For the elderly diabetics it was longer than that for the young persons. Table 81 compared the insulin-dependent and the insulin-independent according to length of stay in hospital.

<u>Table 81</u>: Number of patients admitted in the first year according to type of diabetes and duration of stay.

Period in hospital in first year	MALES				FEMALES			
	Insulin-dependent		Insulin-independent		Insulin-dependent		Insulin-independent	
	No.	Per cent	No.	Per cent	No.	Percent	No.	Per cent
< 2 weeks	30	75.0	34	39.5	21	61.8	46	34.9
> 2 weeks	10	25.0	52	60.5	13	38.2	86	65.1
Number admitted	40	100.0	86	100.0	34	100.0	132	100.0
Per cent of total	83.3	-	35.1	-	85.0	-	40.1	-
Total No. of patients	48		245		40		329	

83.3 per cent and 85.0 per cent of insulin-dependent men and women respectively were admitted in the first year, compared with only 35.1 per cent and 40.1 per cent of insulin-independent men and women respectively. Among insulin-dependent patients who were admitted, the length of stay in hospital was in the majority of them for two weeks or less, while a higher proportion of the insulin-independent stayed for more than two weeks.

"Inpatients" who were diagnosed to have diabetes while in hospital for other causes than diabetes, tended to stay in hospital longer than patients from the other two groups (the "Outpatient" and "G.T.T.", Table 42 in Appendix). 68.4 per cent of men and 77.8 per cent of women in the "Inpatient" group stayed in hospital for more than two weeks, while 40.3 per cent of men and 45.4 per cent of women in the "Outpatient" group had a duration of more than two weeks in hospital.

Admission to hospital was commoner among patients who died than among those who survived (Table 43 in Appendix). 73.2 per cent of men and 52.5 per cent of women who died were admitted to hospital in the first year after diagnosis, compared with 38.1 per cent and 44.1 per cent of survived men and women respectively. Moreover, patients who stayed for two or more weeks in hospital were proportionally more among the dead patients than among the survivals.

The admission to hospital and the duration of stay for the insulin-independent patients who are of middle or old age, are affected by the presence of other diseaaes than diabetes.

Diseases other than diabetes were commoner in those of the "Inpatient" group than in the other two groups, and among the dead patients more than the survivals.

Table 44 in the Appendix shows that the proportion of the economically-inactive patients, especially women, who stayed in hospital for more than two weeks, was higher than that of the economically-active persons.

Only 37.1 per cent and 34.8 per cent of married men and women respectively were admitted to hospital, while 64.0 per cent of men and 57.0 per cent of women of "other" marital status were admitted in the first year (Table 45 in Appendix). Women rather than men with "other" marital status showed a higher proportion over the married, when more than two weeks hospitalisation is considered.

When the age of the patients was accounted for, the elderly diabetics who are of "other" marital status, showed more admission as well as longer duration of stay in hospital than the married. This is also the case among the elderly of the general population.

Morrison (1970), has shown that old people make proportionally more use of hospitals than the rest of the population. He demonstrated that men aged 65 and over represent 8.5 of the male population, but they occupy just over 35 per cent of all male hospital bed days. For women there was a similar picture.

Moreover, it was estimated that the married men use approximately two and a half times their "due" proportion of bed days, but the others occupy seven times the expected proportion.

For women there was a similar pattern.

Rate of hospital admission and length of stay in hospital shows once more the distinction between the two types of diabetics. The young are usually admitted once to hospital in the first year following diagnosis. The cause of admission is to educate them in the principle of self-management. Admission to hospital of the middle-aged and elderly diabetics is on the other hand, governed to a large extent by the social and medical need, common to those of the same ages in the general population.

Disability of diabetics

Data regarding activity restriction, "home-bed" disability, work and school loss days, was collected for the interview sample (249) patients.

The age and sex distribution of patients interviewed is shown in Table 82.

Table 82/

Table 82: Age and sex distribution of patients interviewed

SEX	< 20	20-39	40-59	60-79	80+	All ages
	"NO DURATION"					
Males	9	6	39	25	1	80
Females	8	7	36	80	5	136
Both sexes	17	13	75	105	6	216
Per cent	7.9	6.0	34.7	48.6	2.8	100.0
	"DURATION"					
Males	2	4	7	3	0	16
Females	5	1	6	5	0	17
Both sexes	7	5	13	8	0	33
Per cent	21.2	15.2	39.4	24.2	-	100.0

216 (80 men and 136 females) were newly diagnosed in 1971, and 33 (16 men and 17 women) were patients with "Duration" between their diagnosis and their first attendance in 1971. The age and sex distribution (for both "No duration" and "Duration" groups) is similar to that of all 775 patients studied, which was shown in Table 27.

Definition of terms related to disability: Disability is known for its difficulty in definition, and it is rarely the case that two different authors use the same criteria to define the degrees of disability. In our study, we chose to define the terms according to length of the period of restricted activity in any individual patient per year, using the definitions set by the U.S. National Health Survey (1967) as a guide.

The following is a description of terms used in our study.

Disability: is the general term used to describe any temporary or long-term reduction of a person's activity as a tesult of an acute or chronic condition.

Disability days are classified according to whether they are days of restricted activity, bed-days, hospital days, work-loss days, or school-loss days. All hospital days are, by definition, days of bed disability; all days of bed disability are, by definition, days of restricted activity. The converse of these statements is, of course, not true. Days lost from work and days lost from school are also days of restricted activity for the working and school-age population. Hence, restricted activity is the most inclusive term used in describing disability days, and it is defined as follows:

Restricted-activity day: A day of restricted activity is one on which a person substantially reduces the amount of activity normal for that day because of a specific illness or injury. The type of reduction varies with the age and occupation of the individual, as well as with the day of the week or season of the year. Restricted activity covers the range from substantial reduction to complete inactivity for the entire day.

Person-days of restricted activity are days of the various forms of disability experienced by any one person. The sum of days for all persons represents an unduplicated count of all days of disability.

Bed-disability day: A day of bed disability is one on which a person stays in bed for all or most of the day because of a specific illness or injury. All hospital days for inpatients are days of bed disability; so are those spent in bed at home.

Since the period of hospitalisation and bed-days at home are not linked to the same person, the "home-bed" disability is considered separately from that of hospital days.

Work-loss day: A day lost from work is a normal working day on which a person did not work at his job or business because of a specific illness or injury. If the person's regular work-day is less than a whole day (part-time worker), and the entire work day was lost, it would be counted as a whole work day lost. The number of days lost from work is determined only for persons currently employed (79 patients). Currently employed persons are those who reported that they either worked at, or had a job or business. This included paid work as an employee of someone else, self-employment in business, farming or professional practice, and unpaid work in a family business or farm. Persons who were temporarily absent from their job or business because of a temporary illness, strike, or holiday, are considered as currently employed if they expected to work as soon as the particular event causing their absence no longer existed. Persons who were economically inactive but out of employment (9 patients), were excluded. These were persons without a paid job, who are prevented from seeking work because of sickness, and persons seeking work or waiting to take up a job.

School-loss day: A day lost from school is a normal school day on which a child did not attend school because of a specific illness or injury. The number of days lost from school is determined only for those attending school.

In the following discussion all events of restricted activity, bed-days, etc., are related to the 216 newly diagnosed diabetics, as it was experienced in the first year following diagnosis.

Table 83 demonstrates the number of patients admitted to hospital and their mean duration of stay per diabetic, and per diabetics who are admitted.

Table 83: Mean duration of stay in days in hospital per diabetic, and per diabetic admitted per year (216 newly diagnosed diabetics)

AGE	Total number of patients	Number admitted	Mean duration per diabetic	Mean duration per diabetic admitted
	MALES			
< 20	9	9	13.9	13.9
20-39	6	4	5.0	7.5
40-59	39	16	6.0	14.7
60-79	25	12	14.4	30.0
80+	1	1	21.0	21.0
All ages	80	42	9.6	18.3
	FEMALES			
< 20	8	8	11.9	11.9
20-39	7	6	8.6	10.0
40-59	36	16	9.6	21.6
60-79	80	35	8.6	19.7
80+	5	4	24.0	30.0
All ages	136	69	9.6	19.0

The mean duration of stay for the newly diagnosed patients of the interview sample compares well with those of the 662 newly diagnosed patients mentioned earlier in Tables 77 and 78.

For all ages, the mean duration of stay per diabetic per year for the "interview" patients is 9.6 days in both sexes, and that for all 662 newly diagnosed pati ents studied was 8.4 days for men and 9.8 days for women.

"Home-bed" disability: 45 patients (14 men and 31 women) out of the 216 interviewed, reported bed disability at home during the period of one year following diagnosis (Table 84).

Table 84: Number of patients with home-bed disability and their percentages of total patients with mean duration of stay per diabetic, and per diabetic with "home-bed" disability per year.

AGE	Total number	Number with home-bed disability		Mean duration per diabetic	Mean duration per diabetic with home-bed disability
		No.	%		
	MALES				
< 20	9	1	11.1	1.6	14.0
20-39	6	1	16.7	1.2	7.0
40-59	39	6	15.4	2.9	19.2
60-79	25	6	24.0	13.2	55.0
80+	1	0	-	-	-
All ages	80	14	17.5	5.8	33.3
	FEMALES				
< 20	8	3	37.5	11.3	30.0
20-39	7	2	28.6	4.3	15.0
40-59	36	9	25.0	4.7	18.9
60-79	80	16	20.0	8.1	40.6
80+	5	1	20.0	2.0	10.0
All ages	136	31	22.8	7.0	30.6

17.5 per cent of men and 22.8 per cent of women reported "home-bed" disability. The mean duration of bed-disability at home per diabetic per year was 5.8 days and 7.0 days for men and women respectively. The mean duration per diabetic who reported such disability per year was 33.3 days for men and 30.6 days for women. The mean duration was longest among patients in the age group 60-79. Patients below the age of 20 years had longer period of bed-disability than those in the age groups 20-39 in the case of males and females. Among females it was even longer than that reported by those in the age group 40-59. Among elderly patients above the age of 80 years, only one woman (out of 5) reported bed disability at home.

In 6 out of the 14 men, and in 15 out of the 31 women who reported these disabilities, the principal cause was upper respiratory infection (Table 85). Amother 4 men and 4 women were in bed at home because of other respiratory diseases (mostly chronic bronchitis). Altogether respiratory diseases were responsible for the "home-bed" disability in 71.5 per cent of men and 61.3 per cent of women.

Table 85: Causes of bed-disability at home.

Causes	MALES		FEMALES	
	Number	Per cent	Number	Per cent
Diabetes Mellitus	1	7.1	1	3.2
Cardiovascular dis.	1	7.1	6	19.4
Upper resp. inf.	6	42.9	15	48.4
Other resp.dis.	4	28.6	4	12.9
Other causes	2	14.3	5	16.1
Total No. with home-bed disability	14	100.0	31	100.0
Per cent of total	17.5	-	22.8	-
Total No.of patients	80	-	136	-

Common cold (coryza) and other upper respiratory infections, like any other infection, tends to make the diabetic state difficult to control. Adequate bed rest and good management of the infection would undoubtedly make the situation less difficult to overcome. However, the number of diabetics who were confined to bed because of upper respiratory infection does not suggest that it is commoner in diabetics than in non-diabetics, since it was reported during one year period by only 9.7 per cent (21 patients) of the total 216 patients interviewed.

Diabetes was responsible for "home-bed" disability in only two patients (one man and one woman), and in the case of the man it was following pituitary ablation for diabetic retinopathy, and in the woman it was because of diabetic neuropathy.

Only a slight difference was noted between the insulin-dependent and the insulin-independent regarding "home-bed" disability (Table 46 in Appendix). 18.2 per cent of the insulin-dependent is compared with 21.3 per cent of the insulin-independent. However, the insulin-independent reported a period of bed-disability of more than two weeks more than did the insulin-dependent.

Similarly, the overweight patients reported a bed-disability of more than two weeks more than did those of normal or underweight (Table 47 in Appendix).

Table 48 in Appendix shows that the proportion of the economically-inactive who reported "home-bed" disability were nearly twice as much as those of the economically-active. Moreover, 75.8 per cent of the economically-inactive, who reported such disability, stayed in bed more than two weeks compared with

58.3 per cent of the economically-active persons.

Relating the "home-bed" disability to the marital status shows an interesting finding (Table 49 in Appendix). All the 14 men who reported the "home-bed" disability were married, and more than half of the women were married (16 out of 31).

The proportion of married men and women who stayed in bed at home for more than two weeks were more than those of "other" marital status. This is in contrast to the situation of hospital-bed disability, where it was seen that "other" marital status, especially old persons, had more frequent admission as well as longer stay in hospital.

Work-loss days: Among the newly diagnosed diabetics of the interview group there were 88 (57 men and 31 women) economically active persons. 79 (51 men and 28 women) of them were currently employed during the year under investigation. The other 9 (6 men and 3 women) were not in employment for reasons discussed in Part III of the thesis.

Out of the 79 employed diabetics, 45 (28 men and 17 women) reported work-loss days in one year. The duration of work-loss period is the restricted activity period for the employed group of patients, which includes hospital-days and "home-bed" days.

Table 86 shows the mean duration of work-loss period for employed diabetics per year. For all ages it was 16.4 days for men, and 11.1 days for women. Patients below the age of 20 showed long duration of work-loss, especially among women who had the longest duration compared with the experience of other age groups. This is mainly due to a higher proportion of young patients having work-loss days. In the age group below 20, all 3 men and 4 women who were employed, had work-loss. The proportion of patients with such disability decreased as the age increased. This in turn reduced the mean duration calculated on the basis of all employed diabetics in these particular age groups. It follows that the duration per diabetic with such disability in middle and old age groups is longer than in the younger diabetics.

Table 86: Work-loss days per employed diabetic per year, showing the percentage of those with work-loss of the total employed diabetics, according to age and sex.

AGE	Currently employed diabetics	Diabetics with work loss		Mean duration of work loss in days per employed diabetic
		No.	%	
	MALES			
< 20	3	3	100.0	16.7
20-39	6	4	66.7	11.7
40-59	32	16	50.0	12.3
60-79	10	5	50.0	32.0
80+	0	0	-	-
All ages	51	28	54.9	16.4
	FEMALES			
< 20	4	4	100.0	21.3
20-39	4	3	75.0	8.8
40-59	13	7	53.9	10.4
60-79	7	3	42.9	7.9
80+	0	0	-	-
All ages	28	17	60.7	11.1

Among the non-manual workers (50 persons), the proportion of those who had work-loss was higher than that experienced by the manual workers (29 persons) (Table 50 in Appendix). However, a period of work-loss of more than two weeks was recorded in the majority (13 out of 14) of manual workers, while only 71 per cent (22 out of 31) of non-manual workers had work-loss for more than two weeks.

Table 51 in Appendix demonstrates that the insulin-independent showed work-loss period of more than two weeks more than the insulin-dependent.

Although a higher proportion of the young insulin-dependent patients had work-loss, the duration of such disability is shorter than that experienced by the middle-aged and elderly diabetics, who are mostly insulin-independent. The main cause of work-loss among the young patients was their hospitalisation for the education in self-management. Work-loss among older patients, on the other hand, besides being partly due to hospitalisation, was also due to "home-bed" disability, and other forms of restricted activity. Among the latter group of patients the cause for work-loss was mainly due to other diseases rather than to diabetes.

The duration of certified incapacity for work among the general population showed that those due to diabetes are higher than that of all causes (Digest of statistics analysing certificates of incapacity, D.H.S.S., June 1969-May 1970). However, the estimated median duration for most chronic diseases were higher than that for diabetes (Table 87).

Table 87/

Table 87: Estimated median duration of spell of certified incapacity, terminating in the period 2nd June to 30th May, 1970, analysed by cause (selected causes*)

Causes	Males	Females
All causes	12	10
Malignant neoplasms incl. neoplasm of lymphatic and haemopoetic tissue	48	66
Thyrotoxicosis with or without goitre	54	31
Diabetes mellitus	31	39
Psychosis	48	51
Cataract	77	90
Hypertensive diseases	35	24
Ischaemic heart disease	72	69
Cerebrovascular diseases	78	125
Asthma	13	11
Nephritis and Nephrosis	41	37

Source: Tables 23 and 24, Part 1, Sickness benefit statistics, Digest of statistics analysis certificates of incapacity, Department of Health and Social Security, June 1969-May 1970, London.

These figures cover employed and self-employed population aged 15 to 69 inclusive in case of men, and 15 to 64 inclusive in case of women, and including those unemployed but seeking work, and those who have lapsed from the working population only because of prolonged sickness.

Among men only those with asthma showed a shorter duration than that experienced by persons with diabetes. Women with thyrotoxicosis, hypertensive diseases, asthma, and nephritis and nephrosis, showed a shorter duration than those with diabetes.

It appears that diabetes itself causes a comparatively short spell of incapacity for work. Among the young, incapacity for work is for short duration, and usually occurs in the first year following diagnosis. Among older diabetics, who usually have a longer period of work-loss, other chronic diseases rather than diabetes itself, are usually the cause of incapacity.

Pell and D'Alonzo (1960b), who studied the sickness and injury experience of employed diabetics compared with a control group, reported that the rate of return to work following the onset of illness was somewhat slower in the diabetic group than in the control group. This was true for illness in general and for respiratory infections in particular. However, they did not observe any significant difference in the occurrence of minor injuries between the diabetics and the controls, and in general the great majority of diabetics do not pose any special problem with regard to sickness absenteeism.

Pell and D'Alonzo (1967a) studied the sickness absenteeism during one year period of 622 diabetics employed by the Du Pont Company, and was compared with a series of matched controls. As a group, the diabetics had more bouts of illness, almost twice as many days of disability, and when ill were diabled for a longer period of time. Those who take insulin had slightly more absenteeism than did the mild and moderate cases. Moreover, they reported that respiratory infections occurred with about the same frequency in both groups, but prolonged disability for these illnesses was more common among the diabetics. Absenteeism for the reason of care and management of diabetes was strikingly high among the younger workers who are insulin-dependent.

Wyshak, et al (1961), studied the employment experience of 18 industrial and service organisations in the Greater Boston and New York areas. The absenteeism due to sickness among the 56 diabetics was compared with that among a control group. The sickness frequency rate, defined as the number of absences per 100 scheduled work days, of the diabetics, was equal to that of the controls. The disability rate, which represented the percentage of lost time, and the severity rate, which represented the number of days of disability per disabling incident, were greater among the diabetics than among the controls. The severity rate was 4.8 among diabetics, and 3.1 among the controls. Wyshak and co-workers also studied employees with heart disease and found that this experience was less favourable than for the controls. Experience among diabetics was more favourable than that of the cardiacs.

These studies indicate that the overwhelming majority of diabetics do not pose a serious problem with regard to work-loss. The rates of work-loss among diabetics as a whole might be reduced to a large extent to that of non-diabetics by directing efforts towards obtaining better education and hence better control in a small group of diabetics who are insulin-dependent.

The duration of work-loss among diabetics is influenced to a great extent by two factors. One is that the diabetes itself may contribute to the severity of other illnesses which are the "primary" causes of work-loss. Another, but more likely explanation, especially in cases of juvenile insulin-dependent patients, is that the physician may treat the diabetics more conservatively than he would a non-diabetic for the same condition. For example, when the insulin dosage is increased due to fever, the family physician may believe that a few extra days at home are necessary to regulate insulin dosage to preclude insulin-shock or hyperglycaemia.

<u>School-loss days</u>: The term defines days of restricted activity of all types experienced by children attending school. There were only 10 children (6 boys and 4 girls) in the "No duration" group, and another 4 (2 boys and 2 girls) in the "Duration" group, and were attending school. All the 10 newly diagnosed children,and 3 out of the 4 of the "Duration" children, had school-loss days.

The mean duration per year was 18.7 days for boys, and 21.0 days for girls. The main cause of their school-loss period was hospitalisation for the education in self-management. However, part of the period of school-loss days in some of them was due to restricted activity or to "home-bed" days caused mainly by trivial infection.

The insulin-dependent child presents acutely, and over a few days or weeks he becomes thirsty, has polyuria, loses weight, and then borders on ketoacidosis coma. Diabetes among children can appear at any age, from birth onwards, but is much commoner in children of school age,and their performance obviously changes at school before diagnosis, and it becomes apparent, although one does not anticipate that school teachers will make the diagnosis. Once they have a diabetic child in their class, whoever it may be, the teacher will spot early deterioration, and alert, say, the school nurse, accordingly, if they know that the care at home is less than adequate. After all, the school age diabetic child spends half his working day in the care of the school where there is opportunity to observe the effect of deterioration. The great unknowns of diabetes so far as children are concerned, are still what causes it, and what are the effects of tight control of carbohydrate metabolism. The danger of hypoglycaemia or ketoacidosis in a diabetic child is not significant if the home conditions are satisfactory, and the family are working with their own doctor. This would eventually reduce the school-loss days and lead to normality in the child's life, towards which the aim of all those concerned should be directed.

Restricted activity: As explained earlier, restricted activity is the most inclusive term used in describing disability as experienced by any one person. Table 88 shows the total number of patients who had restricted activity in one year following diagnosis.

68.8 per cent of men and 73.5 per cent of women had restricted activity in one year following diagnosis. Women moreover, had slightly more days of disability than did men For all ages, the mean duration per year was 27.8 days for men and 29.2 days for women.

Table 88/

Table 88: Number of patients with restricted activity and their percentage of the total number of patients, showing number of disability days per diabetic per year, by age and sex.

AGE	Total number of patients	Number with restricted activity No.	%	Mean duration per diabetic per year
	MALES			
< 20	9	9	100.0	17.2
20-39	6	4	66.7	15.8
40-59	39	22	56.4	25.0
60-79	25	19	76.0	39.0
80+	1	1	100.0	21.0
All ages	80	55	68.8	27.8
	FEMALES			
<20	8	8	100.0	21.3
20-39	7	6	85.7	17.1
40-59	36	22	61.1	29.2
60-79	80	60	75.0	30.8
80+	5	4	80.0	32.0
All ages	136	100	73.5	29.2

The mean duration for those below 20 was longer than that for the age group 20-39, after that the mean duration showed progressive increase in each successive age group. The only man in the age group above eighty was an exception because he had a mean duration of 21 days, which is shorter than that experienced by the 19 men in the age group 60-79.

Table 89: Number of disability days from all conditions per diabetic per year, by sex (216 patients)

Disability days	Both sexes	Males	Females
Restricted activity	28.7	27.8	29.2
Home-bed disability	6.6	5.8	7.0
Work loss*	14.5	16.4	11.1
Hospital days	9.6	9.6	9.6

* Number of work-loss days are based on the number of currently employed diabetics (79 patients)

Table 89 shows the number of disability days from all conditions per diabetic per year by sex.

Restricted activity period was the longest of all because it included all types of disbaility as experienced by any individual patient. Work-loss days are calculated for those currently employed only. Hospital-days period is equal in both sexes, and was longer than "home-bed" period.

Since any particular day of disability may be associated with more than one cause, and disability days in the course of a year would be associated with more than one condition, those days of disability due to diabetes alone could not be ascertained separately. Instead, Table 90 shows the number of patients in whom part of the disability period was due to diabetes (for example, the hospitalisation period is due to diabetes and the "home-bed" period is due to other causes). The purpose of presenting it this way is to indicate clearly the number of patients in whom diabetes played no part in causing the disability.

Table 90/

Table 90: Restricted activity associated with diabetes, and that due to all other causes, by sex.

Restricted activity in first year	Both Sexes		Males		Females	
	No.	%	No.	%	No.	%
Patients without restricted activity	61	28.2	25	31.3	36	26.5
Due to diabetes	52	24.1	21	26.3	31	22.8
Due to other causes	103	47.7	34	42.5	69	50.7
Total	216	100.0	80	100.0	136	100.0

28.2 per cent (61 out of 216 patients) had no disability days in the year under investigation. Of the remaining who had disability, 24.1 per cent (52 patients) had part of their disability period due to diabetes. In 47.7 per cent (103 patients) the disability period was due to other causes, and diabetes was not responsible for any part of it.

A higher proportion of men than women had part of their disability due to diabetes. The reverse is true when the disability was not associated with diabetes, where 50.7 per cent of women are contrasted with 42.5 per cent of men.

Distribution of the disability period, according to age (Table 91) showed that in 90 per cent of those below the age of 40 years it was due to diabetes, while 70.3 per cent of those above the age of 60 years it was due to other causes, and in only 5.4 per cent of them it was associated with diabetes. 4.13 per cent of the middle-aged (40-59) showed no disability days, contrasted with only 10 per cent of those below the age of 40, and 24.3 per cent of those above 60 years.

Table 91: Restricted activity according to age and cause, both sexes

Restricted activity in first year	< 40		40-59		60+		All ages
	No.	%	No.	%	No.	%	
Due to diabetes	27	90.0	19	25.3	6	5.4	52
Due to other causes	0	-	25	33.3	78	70.3	103
Patients without restricted activity	3	10.0	31	41.3	27	24.3	61
Total	30	100.0	75	99.9	111	100.0	216

The proportion of the economically-inactive patients who had disability period was higher than that of the economically-active patients (Table 52 in Appendix).

Disability period of more than two weeks was commoner among the economically-inactive than among the economically-active. Moreover, when the social class of patient is considered, the proportion of patients who had disability-days increased from being 66.7 per cent in those of social classes I and II, to 78.4 per cent in patients who belong to social classes IV and V. (Table 53 in Appendix).

Disability among diabetics is also influenced by the marital status of patients. 64.5 per cent and 68.6 per cent of married men and women respectively had disability period, while 83.3 per cent and 78.8 per cent of men and women respectively of "other" marital status had disability days (Table 92).

Table 92/

Table 92: Number (per cent) of patients with restricted activity according to marital status

Sex	Married	"Other"
Males	64.5	83.3
Females	68.6	78.8
Both sexes	66.7	79.8
Total number of patients	132	84

The same association of marital status, social class and economic position with health and the need for medical and social care exists in persons of the general population.

Apart from the situation in young diabetics, who would have the disability in their first year as diabetics, being closely linked with diabetes as such, the majority of diabetics would have restricted activity period, not that different from the one experienced by persons of similar age and sex in the general population.

The U.S. National Health Survey (1967), demonstrated that for diabetics, the rate of restricted activity and bed disability from diabetes alone exceeded slightly the rates of disability from all conditions for the total population.

Reliability of data collected from patients' records of the Diabetic Department

A large part of unrecorded variables in the patients' records of the diabetic department were made known from various sources. These are: patients themselves, hospital inpatient records, and the hospital inpatient statistical returns to hospital authorities.

Patients interviewed were asked about the unrecorded variables and their answers were checked with the available information from the other sources mentioned above. The following discussion deals with four variables unrecorded in the case notes of 249 interviewed patients. The patients' records are those kept in the diabetic department. Unrecorded items include the omitted entries on the patients' case notes, but exclude incorrect entry as this was a rare event in comparison with the omission of the whole item.

The four variables studied represent the socio-demographic, clinical and administrative information about the patient, and these are: marital status, occupation, chronic diseases, and hospital admission. No difficulty was encountered in collecting information of identifying nature. The patient's name, date of birth and sex was completely recorded.

Table 93: Number of patients with unrecorded variables in the patients' diabetic clinic files

	MALES		FEMALES	
Unrecorded variable	No.	%	No.	%
Marital status	42	43.8	34	22.2
Occupation	38	39.6	120	78.4
Chronic disease	6	6.3	11	7.2
Hospital admission	14	14.6	29	19.0
None	32	33.3	26	17.0
Number of patients	96	-	153	-

Table 93 shows that one or more, of the four variables under study, was unrecorded in 66.6 per cent and 83 per cent of men and women respectively. In 42 out of the 96 men (43.8 per cent) the marital status was not recorded, which is the commonest single unrecorded variable among men, while among women, occupation was the commonest single unrecorded variable (78.4 per cent).

The presence of chronic disease was unrecorded in only a small proportion of patients (6.3 per cent of men and 7.2 per cent of women). These diseases were mostly of such nature as chronic bronchitis and arthritis, and when reported by the patients, the clinic's notes were examined again and their presence was confirmed by studying the inpatient case notes.

Hospital admission was unrecorded in 14.6 per cent of men and in 19.0 per cent of women. However not all patients had hospital admission in the year under investigation, and the proportion of patients with unrecorded hospital admission is higher than these figures suggest. When the number of newly diagnosed patients with unrecorded admission is related to the number of patients who actually had hospital admission, it is seen that 13 out of 42 men (31 per cent) and 27 out of 69 women (39.1 per cent) had unrecorded admission (Table 54 in Appendix). The same Table shows that patients over the age of 40 with unrecorded admission were proportionally more than those below 40 years. This is especially so in the case of women. The mean duration of stay per year for those with unrecorded admission likewise shows an increase with age. For all ages the unrecorded mean duration of stay is 17.7 days for men and

24.5 days for women.

From Table 55 in Appendix, which shows the principal cause for the unrecorded admission according to the duration of stay, it will be seen that the duration of stay has no noticeable effect on recording the admission.

The cause of admission on the other hand is seen to influence the recording of the admission. On only three out of 40 newly diagnosed patients the principal cause was diabetes mellitus, while respiratory system, digestive system, and genito-urinary system diseases were the principal causes of admission in 42.5 per cent of the patients. In another 20 per cent of patients the cause was "other", which range from chronic myoloid leukaemis to rheumatoid arthritis. It appears that most of the unrecorded admissions were due to causes other than diabetes, and in more than half of such admissions the principal cause was unrelated to diabetes or to associated diseases like cataract or cardio-vascular diseases.

Unrecorded variables, especially those related to socio-demographic characteristics of the patients, are seen more among insulin-independent patients (Table 56 in Appendix). One variable or more was omitted in 54.5 per cent, and 48.1 per cent of insulin-dependent men and women respectively, compared with 70.3 per cent and 90.5 per cent of insulin-independent patients.

59.7 per cent of men and 43.2 per cent of women who are economically active had one variable or more omitted from being recorded, while a much higher proportion of economically-inactive patients had unrecorded variables (82.7 per cent and 95.7 per cent of men and women respectively). (Table 57 in Appendix).

A higher proportion of women than men had unrecorded items. There was little difference between the married and "other" marital status in the case of women. However, men of "other" marital status who had unrecorded items were proportionally more than married men (Table 58 in Appendix).

From all this it is clear that apart from the clinical information the diabetic clinic records omit from recording, in a large number of patients, information regarding socio-demographic status and hospitalisation. This was seen to be more common among the insulin-independent and the economically-inactive patients.

The difference between unrecorded social and clinical characteristics of the patient was also reported by Lockwood (1971). He studied the accuracy of transcription of hospital morbidity data in 38 hospitals throughout Scotland, and compared the information contained in 2515 morbidity returns with the information recorded in the hospital medical case records. Lockwood found that errors and omissions in transcription and coding of identifying information such as case reference number and patient's name and sex, were each less than 1 per cent, but errors and omissions in occupation was 14.7 per cent, and that in marital status was 2.1 per cent. Individual items related to duration of stay and time spent on the waiting list were shown to have errors and omissions level of up to 3 per cent, while data relating to the principal diagnosis were correctly transcribed and coded in 94 per cent of the forms examined.

A study of a sample of records from eight general practices (Dawes, 1972), showed that the situation is more serious when general practice records are considered. Dawes showed that in only 10 per cent of the records examined the patients' ages were not recorded, while 99 per cent of males had no indication of their marital status, and 60 percent did not have an occupation recorded. In recording of disease episodes a diagnosis was recorded in a little over half of the episodes and was the only recorded item in 10 per cent of records.

In our study, although clinical information was the least unrecorded, difficulties were faced with trying to trace a recorded disease as continuity of follow-up reports was not adequate. For example, the information about the progress of the heart condition in a diabetic with ischaemic heart disease would not appear in the follow-up reports for one or two visits. Although this might be due to the fact that the care of patients' other diseases are looked after by other departments, it does suggest that the patient's diabetes rather than the patient as a whole is the concern of the reporting doctor. Apart from unrecorded hospital admissions, patients' admissions were sometimes referred to, in the case notes, in unclear and ambiguous ways. In such cases the hospital inpatient records were always consulted to determine the cause as well as the duration of stay of such admissions.

The problem-oriented medical records system (Weed, 1971; Bjorn & Cross, 1970; Cross, 1974) which records not only the diagnosis but probably more important from the patients' point of view the problems which are presented by the disease process, is one solution to the difficulties discussed above. The problem-oriented medical records system is one with continuous evaluation and updating of each of the patient's medical and social problems. It is designed to keep all problems, plans, and follow-up notes clearly in view. The usual record system is a mixture of information about all types of problems, with no regular index, which make it impossible to retrace the patient's complaints at each of his follow-up visits. Consequently the care of the patient cannot be adequately planned. Unless the patient's problems are well identified and documented in a systematic way the quality of medical care cannot be guaranteed.

The cost of Diabetes in the Health Service

In assessing the economic importance of diabetes one must take into account the cost of the health service provided for the diabetics, and the economic loss from sickness absence for the employed diabetics. However, the total cost of ill-health comprise not only the direct cost of therapy and the value of lost production by the working class, but also the indirect economic and social losses falling on the individual patients; they or their kin or the community as a whole suffer deprivation from ill-health and premature death. On the other hand the benefit from providing health services cannot be fully appraised until it is balanced against indirect but real benefits the community derives from such services.

The economic loss from sickness absence can be considered to consist of the sickness benefits which are the payments paid by the National Insurance Fund and part of the cost is borne by the individuals themselves in the form of loss of earning which is made up by benefits or by employers through private sick pay schemes which may make up their earnings for them. Thus the monetary cost of absence from work can have a number of components, but overall the loss to the community through absence is equal to the loss of goods and services which would have otherwise been produced. In addition to this one can add the personal costs of disability to the individual.

The value of lost production according to some economists like Rice and Copper (1967) is equal to the gross remuneration which would have been received by persons off work had they remained at work. This has been considered the total loss regardless of where the burden of payment falls. Thus multiplying the total number of days lost through certified sickness and injury by the average gross remuneration per day of the working population, increased by ten per cent to account for uncertified sickness absence, produces the total figure of cost of sickness absence (Office of Health Economics, 1971).

Such calculation does not truly reflect the real economic costs of sickness absence. It is true that other things being equal the eradication of sickness absence would theoretically provide an opportunity for the working population to increase their income. However, the total number of hours in the working week from which the lost time percentage is calculated is a fixed and immutable quantity. In reality the standard working week is an arbitrary variable and time lost through sickness absence can be, and is made up for through overtime or possibly a lomger standard week. The cost cannot be measured by the value of time covered by sickness absence. It may be the case that in times of low demand the full work force is not needed.

The Office of Health Economics proposed that instead,attention should be concentrated on the disruptive effects of sickness absence and the complex personal costs to the sick individual. However, it is difficult to calculate the monetary value for either of these, but the possible effect can be described.

Diabetics, especially the young insulin-dependent, have been shown to have short-term absence from work which is likely to be associated with more costly disruptive effects than the long-term absences characteristic of other chronic diseases and disabilities. The necessity to switch manpower round to fill temporary gaps will normally be more expensive than making long-term adjustments in the labour force. This is particularly relevant in the case of industries where the absence of key men can jeopardise the operation of expensive processes and the effect may extend well beyond the work unit in which the absence occurs. Fortunately diabetes has a low incidence among young adults and the early middle-aged,and the situation where disruption occurs in industry because of diabetes is very rare.

From the point of view of the individual on the other hand, different priorities are indicated. It is the long-term rather than the short-term illness characteristic of older diabetics which is likely to be associated with the severest disability. Long-term absence is likely to impose the severest economic hardship on the individual. The long-term sick must often adjust to permanently lower incomes and as a group they are among the most underprivileged in the community.

Although diabetes is a long-term illness it has (as has been shown), a low incidence in the sickness figures and therefore does not contribute greatly to total long-term sickness. Bronchitis causes short spells of sickness absenteeism, but because of its frequency is important in the total figures.

In travelling to his family doctor or to the hospital clinic, the diabetic might face a considerable problem of transport, which may not only be expensive but also necessitates a day off work.

Forster (1971), Gruer (1972) and Porter (1974) reported that the distance between the patient's home and the hospital plays a major role in the pattern of the patient's attendances. If the patient himself is not a car driver or owner, and if no bus is available, a friend or a relative may also have to take time off work to take the patient to hospital, or an ambulance will have to be used.

The cost of diabetes to the health service can be considered as being the hospital costs, and the cost of the general medical services, which comprise the general practitioners' services, dentists, ophthalmologists and domiciliary nursing services. This should be supplemented by estimating the costs of "medical goods" delivered to patients, i.e. drugs and other dispensing items.

The present study did not cover the general medical services as they are offered to diabetics; nevertheless in the following discussion we will try to use the estimation of cost from data of our study and other studies to compare the costs of hospital services with those of the general medical services. The estimation of cost will be per diabetic rather than the cost of diabetes and, as will be seen, the estimation is only an approximation, and far from being comprehensive.

The cost of hospital inpatient care per diabetic per year is estimated to be £57.61, calculated on the basis of average net cost per patient per week for all types of hospital in Scotland, excluding mental illness and mental deficiency and maternity hospitals. This was weighted by the average daily number of occupied beds (Scottish Health Statistics, 1970, Tables 7.2 and 7.22*).

The cost per attendance to the outpatient departments of the Royal Infirmary of Edinburgh is £1.29 (Scottish Hospital Cost, 1970). Assuming that this is applicable to the diabetic and dietetic department, the cost of the diabetic outpatient services per diabetic per year would be £4.90** This is an underestimation of the actual cost because diabetics, especially the elderly with chronic diseases, may attend other outpatient departments more than the diabetic one, and hence the total number of attendances is obviously more than that made to the diabetic department alone. For example, an old lady with rheumatoid arthritis and diabetes may attend the rheumatology or physiotherapy department much more frequently than the diabetic department.

The number of attendances at the clinic and the duration of hospitalisation after the first year following diagnosis were seen to decrease. However, the figures quoted above show that for the first year's experience the cost of hospital inpatient services

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* The average duration of stay in hospital per diabetic per year is taken to be that of the first year's experience after diagnosis, which is 9.18 for both sexes. The weighted average net cost per patient of the general population per week for all types of hospitals in Scotland (excluding mental illness, mental deficiency and maternity) was calculated to be £43.93.

**The mean number of attendances at the diabetic outpatient department in the first year following diagnosis is 3.8 for both sexes.

per diabetic is about ten times as expensive as the outpatient treatment.

The hospital services costs published in the reports of the Health Service in Scotland, showed an increase in each successive year (Health Service in Scotland, Reports for 1971 and 1972), which was due partly to inflationary factors and partly to an increase in real terms. The cost of the hospital and specialists' services "excluding capital expenditure and certain ancillary services" was £155,228,000 in the financial year 1971/72, compared with £131,788,000 in 1970/71, and with £110,713,000 in 1969/70. This was equal to an increase in real terms of 4 per cent from 1970/71 to 1971/72, and of 3.5 per cent from 1969/70 to 1970/71.

The average weekly cost per inpatient was £47.17 in 1971/72, compared with £39.75 in 1970/71, and with £33.19 in the previous year. The average cost of outpatient treatment for the year to 31st March 1972 was £1.58 per attendance, compared with £1.40 in 1970/71, and with £1.20 in the previous year.

No recent data have been published on the subject of general practitioners' consultations by diabetics. The last data available are from a study done in 1955 (Logan & Cushion, 1958) of 106 general practices throughout England and Wales, and revealed a consultation rate for diabetics of 3.7 per 1000 population per year (2.9 for men and 4.4 for women). The corresponding figure for all diseases and conditions was 670 (635 for men and 702 for women). The total number of consultations per 1000 population per year for diabetes was 27.2 (19.9 for men and 33.7 for women), and for all diseases and conditions it was 3751 (3385 for men and 4076 for women).

Thus the number of consultations per diabetic per year is 27.2 / 3.7 = 7.4, and that per patient suffering from all diseases and conditions is 3751 / 670 = 5.6.

The average annual income of general practitioners in 1970-71 was £7,200 (Royal College of General Practitioners, 1973), and the average cost per general practitioner consultation was calculated to be £0.92*. Multiplying the cost per consultation £0.92) by the average number of consultations per diabetic per year (7.4) will result in the cost of general practitioner services per diabetic per year (6.81). In the same way the cost per patient of the general population is estimated to be £5.15. These costs do not include the cost of prescribed drugs because this information is not available.

The cost of general practitioner services per diabetic was based on the average number of consultations recorded some 20 years ago. This seems not to be exactly the situation in recent years. The practice among the majority of general practitioners nowadays is to refer the patients to the clinic for confirmation of diagnosis and for control and education, and after that the

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* In Scotland, for the year 1971, the average general practitioner's list contains 2078 patients (Table 6, R.C.G.P. 1973).

$$\text{Average cost per consultation} = \frac{\text{average annual income}}{\text{average list size x consultation rate per patient}}$$

$$= \frac{7200}{2078 \times \frac{3751}{1000}} = £0.92$$

patients seldom see their general practitioner again, at least not for problems associated with their diabetic care. Porter (1974), in his survey of the diabetic clinics in the Royal Infirmary of Edinburgh and of the Victoria Hospital in Kirkcaldy, showed that only 21 per cent of Edinburgh clinic attenders and 15 per cent of Kirkcaldy clinic attenders remembered ever consulting their general practitioners about their diabetic care. Of those who had experienced difficulty in the control of their diabetes, only 23 per cent of Edinburgh attenders and 13 per cent of Kirkcaldy attenders replied that they remembered consulting their general practitioners. Only 4 per cent of patients studied by Porter recalled being visited by either the district nurse or the health visitor.

The Queen's Institute of District Nirsing in Edinburgh conducted a survey in February 1972 (Marquis, 1973) to ascertain the number of diabetics visited by district nurses. The survey discovered 61 diabetics (13 men and 48 wo en) 41 of whom were above the age of 70 years. These 61 patients were receiving one visit a day mainly to administer their daily insulin injections. The visits were paid by 85 registered general nurses and 11 state enrolled nurses.

The weighted average cost per visit is £0.27*. However, the

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*Edinburgh University Nursing Research Unit supplied the cost of the district nursing service per patient visit (Hockey, 1973): The cost per hour (based on a 40-hour working week and including travel, equipment, uniform expenses, etc., but excluding administrative nursing costs) was calculated to be £1.10 for the R.G.N. and £0.90 for the S.E.N. On average each visit consumes about a quarter of an hour of the nurse's time.

61 patients receiving home visits represent only a small proportion of the total diabetic population in Edinburgh (about 3000), and hence the cost per diabetic would be negligible. The cost per diabetic per year would be £2.27.

From the above description it is apparent that the cost of inpatient care claims the largest share of the total cost of health services to diabetics. In 1961 in England and Wales, the cost of diabetes to the National Health Service, for hospital inpatients and for treatment in general practice, amounts to approximately £5.7m (Office of Health Economics, 1964b). The largest part of the cost is for inpatient care, amounting to approximately £3.7m, or just over £100 per hospital discharge or death following an average stay of 26 days.

The cost of outpatient attendances at diabetic clinics was £0.5m. The cost of care outside hospital was much lower, amounting to an average of about £9 per diabetic per year. The year's supply of pharmaceutical preparations accounts for just under £5, and an allocation of the general practitioners' consultations for nearly £2, the balance of £2 being attributed to outpatient attendance.

Comparing diabetes with other diseases in the same category of allergic, endocrine, metabolic and nutritional diseases, it was seen that diabetes cost of £5.7m was the highest, asthma coming next with a total cost of £4.3m. £2.6m and £0.6m were the total costs of obesity and hay fever respectively. The high cost of diabetes was largely due to hospital costs, and both asthma and obesity cost more than diabetes if the general medical services and pharmaceutical services were considered.

The cost of the hospital service to the diabetic has undoubtedly increased since 1961. The day to day care of diabetics and their education in self-management is inclined nowadays to be done in the diabetic clinic and in hospital. Thus the share of hospital cost out of the total cost of diabetes is bound to increase.

The lack of general practice involvement may be partly due to the general practitioners' willingness to let the hospitals relieve their own work load, thus adding to the clinics' experience of the lack of general practitioners' interest, with consequent fears for the patients condition if returned to general practitioner supervision. This will be followed by more diabetics attending the hospital clinics and a situation would be reached where clinic doctors would have to work hard and fast if they were to see each patient, with the likely result that some patients could not be given the time needed to bring them under proper control or to give them confidence in self-management of their diabetes.

The highly specialised hospital services could only be adequately utilised by a closer working arrangement between hospital and general practice. With the family doctor looking after the day to day management of diabetics and attending to other medical needs, the specialist in the diabetic clinic could spend longer time with the patient when referred there. In this way not only the patient would be benefitted, but also the clinic staff and the general practitioners, who could then offer more satisfactory service.

Malins and Stuart (1971) suggested that the majority of the approximately 500 diabetic clinics in Great Britain are burdened with a heavy load of routine work: "patients tend to rely on them for regular medical care, so that by degrees the family doctor may cease to take an interest in their problems and in diabetes in general".

Cochrane (1972) believes that an integrated diabetic service should benefit the patient, the hospital clinic and the general practitioner. Thorn and Russell (1973) expressed the same opinion and pointed out that if hospital diabetic clinics in densely populated areas continue to try to look after most of the diabetic population, the service which they provide will deteriorate steadily owing to overcrowding. They reported the success of establishing 14 "mini-diabetic clinics" in general practice in the Wolverhampton area. Provided that those patients whose diabetes is difficult to control, or who need extra care, remain the responsibility of the hospital diabetic department, the system of diabetic clinics in general practice is to the advantage of patients in that they receive better care than they received from the hospital clinic. Most recently, Russell (1974), reported the average number of consultations made by diabetics to these "mini" clinics in general practice, to be 4 per patient per year. Those treated by insulin consulted at the highest rate, i.e. 5.2, whereas those controlled by diet or by oral drugs consulted at rates of 3.0 and 3.7 respectively. This shows that even in these special diabetic clinics the consultation rate is much lower than that reported by Logan and Cushion 20 years ago.

The interest of the general practitioner in diabetes could be stimulated by supplying him with the essential requirements of good general practice and with the necessary diagnostic tools. Without the fulfilment of such requirements, the practitioner will cease to have a realistic number of diabetics under his care, and will consequently increase the load on hospital clinics. The implementation of vocational training, the provision of diagnostic tools and the development of organisation within general practice all help to create a true community health service readily available for the needs of every diabetic.

There are difficulties for the implementation of these requirements, and it could best be effected within group practices or in health centres - there is little point in stimulating the interest of a general practitioner and equipping him with diagnostic tools if he has only one or two diabetics under his care. There is, we think, a place for the service if the care of diabetics from the locality were to rest in the hands of one or two of the doctors working within a health centre or group practice. Strengthening the front line medical care by supplying the group practices and health centres with the necessary facilities for the care of diabetics will also have the advantage of making it possible to carry out screening for the early detection of diabetes, and by analysing the morbidity data of the population it will become possible to plan according to the particular priorities of the area served.

We believe that diabetic care should be a carefully planned service involving hospital and general practice staff, which would take account of the limitations of hospital and general practice resources, patient costs and variations in the interest and ability of the general practitioners. The planning and organisation of medical and social services for diabetics must depend on information about the needs of such patients. We have seen that the elderly insulin-independent, who is economically inactive and of lower social class, shows more disabilities than the young insulin-dependent patient.

The reorganisation of health services, with its promised integration of services, would benefit the patient with diabetes only if it recognises the need for close liaison between the diabetic clinic in hospital and the other medical and social organisations outside the hospital. The care of diabetics in the clinic should be supplemented and continued by the services of the family doctor, district nurse and social worker. The patient should be at the centre of a well coordinated system of medical and social services. If the medical care is to be beneficial it should be supplemented by social services. These services would require to develop their role in supplementing family care of the elderly diabetic, as well as substituting for it. Elderly diabetics of lower socio-economic status obviously need extra care at home to help them to cope with their diabetes, which is usually accompanied by other medical, social and financial difficulties.

The social needs of diabetics should be recognised as being the same as those of any other member of the community. The social necessities of security, personal achievements and self-fulfillment also apply to the diabetic. Accepting him in society as a normal person, offering him the opportunity of suitable work, and helping and advising him in certain difficulties, would no doubt enable him to lead a normal life and be fruitful in that he becomes a functional member of society.

Total care of the diabetic should include the care of his disease(s) as well as his social, financial, and home situation difficulties.

The patients who would benefit most from integration of the health service are most likely to be those who, because of attitude, tradition, or inadequate education, fail to recognise their own needs and make them known. It is the duty of the reorganised health service to identify the vulnerable diabetics and direct help to them. The integrated health services should aim to discover the requirements of diabetics, especially those of elderly patients, so that necessary services are made available to them instead of the existing practice of offering the service only on demand.

Care of the diabetic patient

Although the patient himself has to some extent the responsibility of maintaining adequate control of his diabetic state, the medical and social welfare services have the greater responsibility of maintaining the supply of the essential services for the diabetics.

The medical and social care system should be directed in such a way as to restore normality to the life of the diabetic. There has been a great swing of the pendulum from the days when the diabetic was regarded as handicapped, when he had to have special provision of food, and so on, to the situation now, where he should have as normal a life and as normal activity as his counterpart in the community.

"I don't believe it!" "Why, or how has it happened?" "Don't expect me to give injections to myself." "What a terrible life, never able to eat sweets." These exclamations, and many others, I have heard stated by patients who have just been diagnosed as having diabetes. When the diagnosis is confirmed, the success of the education of the patient and his confidence in being able to cope, depends on how completely and confidently the team of the medical and social care system would act, and how much they involve themselves with the patient from the beginning.

The education is the most important part of the patient care, and this is done by the diabetic clinic team, who are more experienced with diabetic management. The aim of the education programme is to make the patient feel fit and secure in the knowledge that he is capable of caring for himself. This must therefore be a concentrated course, and therefore there is no room for confusion in the information delivered to the patient. The patient should not be confused with different stories. The advice given must ensure there is no loss of faith in therapy as a whole. Differences of opinion such as someone saying that the patient could have ice cream, and someone else saying that he must never have ice cream, can cause a great deal of loss of faith in the therapeutic situation. Everyone concerned with diabetic management - the hospital team, family doctor, and the district nurse - should construct a consistent policy and adhere to it, and "let us not confuse people with what we think", Sir Derrick Dunlop said in 1942.

The third point regarding diabetic care, after normality and certainty, is the simplicity of care. If the system of diabetic care is to be practical, it should be as simple as possible. Gone are the days, as has been said in recent years, when one needed a higher qualification in mathematics to be a diabetic . The days of elaborately calculated diets and doses of insulin for the diabetic are past.

Thinking in terms of the use of insulin, this is still an imperfect instrument. Since it is an animal insulin, antibodies are produced in response to it, and to the less pure preparations, particularly to the beef insulins which are commonly used in this country. This does not really make it impossible to treat the insulin-dependent patient. One simply needs to find the dose required to give him free insulin to act and to control his carbohydrate metabolism. And this dose has usually nothing to do with the severity of his diabetes, though it may have a lot to do with the immobilisation of part of the injection as a result of antibody action. When it comes to the kind of insulin, gone are the days when, if one could not stabilise a diabetic on one insulin or another insulin, one kept on changing insulins rather than have the belief that there might be some other factor in the patient's environment, be it food or anxiety or exercise or whatever, that was having an influence on his control. For young diabetics, insulins that are more flexible in action, soluble and isophane insulin, which are short and intermediate acting insulins, are given once or twice daily for a smooth action. Insulins in suspension or protamine zinc insulin, are more suitable in the case of older insulin-dependent patients.

It would be much nearer to the principle of normality if it were possible for the patient to select his food from normal food, rather than to have some specially prepared food. The aim is to move right away from these impossibly rigid regions of twenty to thirty years ago, when calories were counted, and protein and fat were also taken into consideration, towards a more liberal method, using carbohydrate restriction in a sensible way as a basis for diet control. The patient can vary the diet from one day to another, as long as he knows the total amount of carbohydrate he is allowed to take every day. Flexibility in diet means that if a young lady is not having high tea that night at 5 o'clock, but is going out to have a meal with a boyfriend at 7 o'clock, then she can take part of her carbohydrate exchanges at 5 o'clock, and have the balance of her allocation at 7 o'clock, instead of being inflexible and letting her sit there watching the boyfriend eating his steak.

Diabetes control can be assessed in a simple good old-fashioned way, and that is, by urine tests. The urine tests done by the patient at home, supplemented by blood sugar estimation at the time of the patient's visit to the clinic, are reviewed by the clinic's doctor on each visit. These tests are used to judge what is going to be done regarding the patient's therapy, whether he is adequately controlled on his present regime, or it has to be changed. For example, was one insulin injection in the morning enough, or is an extra injection needed in the evening; or whether the dose of an oral drug needs alteration or not.

It is difficult to construct a measure for the degree of diabetes control. Many authors studying this subject among diabetics used the blood sugar level at the patient's visit to the clinic as an indicator. This, besides being an inadequate index, is an inefficient one in the case of some patients. It is inadequate because it does not take into account the fluctuation in the blood sugar during theintervening periods between the patient's visits. It is inefficient because in an aged patient, who is free from symptoms, and who has minimal glycosuria, there would be no cause for scrupulous blood glucose control. Assessment of control is complicated by the type of diabetes, the age of the patient, and the presence of other diseases, especially those which may shorten life.

The degree of control has not been described for patients of our study because of the above mentioned points, and mainly because the duration of the disease in the majority of our patients was too short to allow an assessment of the effect of the degree of control of their health status.

CONCLUSIONS

CONCLUSIONS

An attempt has been made in the preceding study to determine the incidence of diabetes and factors affecting it, and also to evaluate the present position with regard to the quality of life of the individual suffering from diabetes at time of discovery of the disease, and his use of facilities available in the National Health Service for the treatment of his diabetes, its complications and other concurrent diseases.

The main findings have been:

1) The incidence is in no sense an absolute figure but depends on the services available for diagnosis and treatment, and in the case of the insidious diabetes of the elderly, on the accident of another illness which might cause the patient to have medical supervision and a routine urine or blood sugar test. In some, the accident is an insurance, superannuation or other routine medical examination. However, the incidence and prevalence in the prevailing medical conditions in Edinburgh have been ascertained and elaborated.

   Since diabetes is a disease of the elderly its incidence, as far as concerns provision of medical services, has been growing and can be expected to grow in the future with the increase in the proportion of elderly in the population.

2) There is a tendency for the severity of originally mild diabetes to increase with age, either gradually or in a stepwise fashion, as a result of stresses or infections, and therefore patients with long duration of diabetes can be

expected to call more on the facilities of the service.

3) About half of the diabetics studied in the age group 40-79 were overweight by 10 per cent or more of their standard weight. The percentage distribution of weight showed that men exceeded women in the normal and over-weight range. Moreover, an excess of women over men was seen in the under-weight zone (by 10 per cent of the standard weight). The clinical impression that diabetic women are more obese than diabetic men is presumably due to the fact that normal women gain more weight with age than do normal men.

4) The incidence of diabetes among married women is higher than among single women and among men (married and single together). Parity, menopause, and the association of obesity with parity, might be the possible explanation for the higher incidence in married women.

5) A large proportion of diabetics, because of the age and not because of any disability, are economically-inactive. This is mainly because of the fact that a large proportion of diabetic men and women are beyond pensionable age. Diabetics who were economically-inactive were proportionally higher than the economically-inactive in the general population.

6) As regards diabetes complications present at the time of diagnosis, the majority were found in patients above the age of sixty years. Following the patients for a short interval - one to four years - showed that the increase in complications was mainly in the same age group of sixty years and over. Age-standardised rates of complications varied according to

type of treatment (insulin, oral drugs, diet alone). The complication rates were higher for insulin-dependent patients than for those treated by oral drugs or diet alone.

7) The much discussed higher risk of concurrent illnesses such as cardiovascular disease, cataract, auto-immune disease and others was confirmed, but much of it was shown to be due to the higher ages in which diabetes is found; the better medical care that diabetic patients seem to receive; and the fact that diabetes is more likely to be diagnosed in such a patient than in an elderly person without any disorder.

Since much higher incidence of chronic diseases were present among diabetics who are above the age of sixty, these diseases were found among the insulin-independent, the obese, and the economically-inactive diabetics.

8) As one would expect the association of one or more disease conditions, with diabetes among patients who died, was greater than among survivors. The majority who died within the short period of observation (within four years from time of diagnosis), were above the age of sixty years at time of diagnosis. Cardiovascular diseases were the cause of death in more than half of the patients.

9) The referral of diabetes to the diabetic clinic was seen to be influenced by the degree of medical need of the patients. The young insulin-dependent diabetics were referred to the clinic to be educated in insulin self-regulation. The elderly patients who usually present themselves to the family doctor with other diseases as well as diabetes, tend to be referred more readily to the diabetic clinic. Because young diabetics need more frequent insulin-dose adjustments they

attend the diabetic clinic more often than the older insulin-independent patients. Especially so in relation to attendances in the first year following diagnosis.

10) Rates of hospital admissions and length of stay showed once more the distinction between diabetics according to their age. The young are usually admitted once to hospital in the first year following diagnosis. The cause of such admission is to educate them in the principle of insulin-self-management. Admissions to hospital of middle-aged and elderly diabetics is, on the other hand, governed to a large extent by other medical and social needs, common to those of similar ages in the general population. Elderly diabetics were admitted to hospital mainly because of diseases other than diabetes. However, diabetes is thought to be a factor in the longer hospitalization period experienced by the old patients. Middle-aged patients (40-59 years) had the lowest rate of admission and hospitalization period,because among them the insulin-dependent patients are few and the frequency of chronic diseases is less common.

Although diabetics were shown to have a longer period of hospitalization than the general population, relatively little of it was attributed to diabetes

11) Work-loss and bed-disability at home during the first year following diagnosis were more common among the young insulin-dependent patients. However, the duration of such disabilities among the young was shorter than that experienced by the middle aged and elderly diabetics. A common cause of bed-disability at home was upper respiratory infections. The main cause of

work-loss among the young patients was their hospitalization for insulin-self-regulation. Work-loss among older patients was due to hospitalization, bed-disability at home, and other forms of restricted activity. Absence from work of older patients was often due to causes other than diabetes.

The duration of work loss among diabetics is influenced to a great extent by two factors: one is that the diabetes state itself may contribute to the severity of other illnesses which are primary causes of work-loss. Another, but more likely explanation, is that the physician may treat the diabetic more conservatively than he would a non-diabetic for the same condition.

12) Restricted activity is the most inclusive term used in the study to describe disability as experienced by any one person. Restricted activity in the young diabetic was mainly due to, or associated with diabetes itself, while in elderly patients it was closely linked with their advanced age.

13) Apart from the clinical information the diabetic clinics' records, in case of large numbers of patients, omit from recording such information as their socio-demographic status and their hospitalization. This was seen to be more common among the insulin-independent and the economically-inactive diabetics.

14) Discussing the economic importance of diabetes in the health service, it was shown that the hospital cost is the most expensive of all services used by diabetics, and it is suggested that to make the best of the available resources and to serve

diabetics more adequately, a closer liaison should be established between the hospital clinic and other medical and social services outside the hospital.

APPENDIX A

FORMA 1

Patient No.

D.O.P.D.No.

Page 1

PATIENT NUMBER

YEAR OF FIRST ATTENDANCE AS DIABETIC (Also for G.T.T. patients) [ ][ ][ ][ ] 1-4

1 1969
2 1970
3 1971

[ ] 5

TYPE OF REFERRAL TO DOPD

1 Outpatient	3 G.T.T.Group
2 Inpatient	X NK

[ ] 6

STATUS AS IN 31.12.72

1 Alive and attending
2 Closed file
3 Dead
X NK
Y NA

[ ] 7

TYPE OF ATTENDANCE

1 Regular	X NK
2 Irregular	Y NA

[ ] 8

YEAR OF DIAGNOSIS

1 1969	X NK
2 1970	Y NA
3 1971	
4 Before 1969	

[ ] 9

CURRENT AGE AT 31.12.72, OR AGE AT TIME OF DEATH

NK = XX
NA = YY

[ ][ ] 10-11

SEX

1 Male 2 Female

[ ] 12

OCCUPATION

1 Manual	5 Unemployed
2 Non-Manual	6 Retired
3 Housewife	7 "Other economically inactive"
4 Student	X NK
	Y NA

[ ] 13

FORMA 1

Patient No.

Page 2

SOCIAL CLASS

1 I
2 II
3 III
4 IV
5 V
X NK
Y NA

14

AGE AT ONSET

XX = NK
YY = NA

15-16

AGE AT DIAGNOSIS

XX = NK
YY = NA

17-18

AGE AT FIRST ATTENDANCE (Also for GTT Group)

XX = NK

19-20

DURATION OF DIABETES (In years)
(Since Diagnosis till 1st attendance)

XX = NK
YY = NA
00 = None

21-22

DIAGNOSIS MADE BY

1 G.P.
2 Insurance checking
3 Patient
4 Hospital
5 Others
X NK
Y NA

23

INITIAL ATTENDANCE WEIGHT (AS PERCENTAGE OF st.wt.)

1 <90%
2 90+%
3 100+%
4 110+%
5 120+%
6 130+%
7 140+%
X = NK
Y = NA

24

TYPE OF DIABETES

1 Insulin Dependent
2 Independent
3 Uncertain
X NK
Y NA

25

INITIAL TREATMENT

DIET ALONE

1 Yes
2 No
X NK
Y NA

26

CHANGE TO

1 OHA
2 INSULIN
3 No
X NK
Y NA

27

FORMA I

Patient No.

Page 3

ORAL DRUGS

1 Yes X NK
2 No Y NA

28

INSULIN

1 <40 units X NK
2 >40 units Y NA
3 No

29

DIABETIC COMPLICATIONS

PROTEINURIA

0 Consistently Absent
1 Intermittently Mild
2 Consistently mild/moderate
3 Consistently Severe
X NK
Y NA

30

RETINOPATHY

1 Right 0 None
2 Left X NK
3 Both Y NA

31

INTER. CLAUDICATION
(Includ. D. Gangrene)

1 Yes X NK
2 No Y NA

32

NEUROPATHY

1 Yes X NK
2 No Y NA

33

DIABETIC FOOT ULCER

1 Yes X NK
2 No Y NA

34

CONDITIONS ASSOCIATED WITH DIABETES PRESENT AT FIRST ATTENDANCE

1 Cataract
2 Thyroid Dis.
3 Per.Anaemia
4 I.H.D.
5 Per. Vas. Dis.&Arteriosclerosis
6 Long Term steroid therapy
7 Carcinoma of Pancreas
8 Other causes of secondary D.M.
9 Others
0 None
X NK
Y NA

35

FORMA 1

Patient No.

Page 4

CONDITIONS PRESENT AT 1st ATTENDANCE

1 Diabetes and its complications
2 Diabetes self regulation
3 Other Endocrine & Metabolic Diseases
4 Hypertension, and disease of peripheral vascular system
5 Heart diseases
6 Upper Respiratory Conditions
7 Other Respiratory Conditions
8 Digestive System Diseases
9 Genito-Urinary Diseases
0 None
X NK
Y NA

36

OTHER CONDITIONS PRESENT AT 1st ATTENDANCE

1 Anaemias & other Haemopoetic Disorders
2 Cerebro-Vascular Diseases
3 Diseases of the Nervous System Sensory Organs and Mental Disorders
4 Cataract
5 Arthritis and Rheumatism
6 Neoplasms
7 Diseases of the Skin & Subcutaneous tissue
8 Accidents and Injuries, poisoning
9 Others
0 None
X NK
Y NA

37

Conditions present as at (or at time of death) 31.12.72: Col. 38
other Conditions present as at 31.12.72: Col. 39
(Codes Cols. 36 & 37)

38 39

No. of Attendances at the Clinic

00 = None YY = NA XX = NK

1st year________ 40-41

2nd Year________ 42-43

3rd Year________ 44-45

4th Year________ 46-47

No. of Hospital Admissions in 1st Year

0 = None Y = NA X = NK

48

CAUSES OF ADMISSION IN FIRST YEAR

(Code as Col. 36) Col. 49____ 49

OTHER CAUSES OF ADMISSION IN FIRST YEAR

(Code as Col. 37) Col. 50____ 50

PERIOD IN HOSPITAL IN 1st YEAR

000 = None YYY = NA XXX = NK

wks. dys. 51-5

NO. OF HOSPITAL ADMISSIONS IN 2nd YEAR

0 = None Y = NA X = NK 54

CAUSES OF ADMISSION IN 2nd YEAR

(Codes as Co. 36) Col. 55_____ 55

OTHER CAUSES OF ADMISSION IN 2nd YEAR

(Codes as Col. 37) Col. 56_____ 56

PERIOD IN HOSPITAL IN 2nd YEAR

000 = None YYY = NA XXX = NK

wks. dys. 57-5

No. of admissions in 3rd year

0 = None Y = NA X = NK 60

CAUSES OF ADMISSION IN 3rd YEAR

(Codes as Col. 36) Col.61_____ 61

OTHER CAUSES OF ADMISSION IN 3rd YEAR

(Codes as Col. 37) Col.62_____ 62

PERIOD IN HOSPITAL IN 3rd YEAR

000 = None YYY = NA XXX = NK

wks. dys. 63-65

FORMA 1

Patient No.

Page 6

NO. OF ADMISSIONS TO HOSPITAL IN 4th YEAR

0 = None Y = NA X = NK 66

CAUSES OF ADMISSION IN 4th YEAR

(Codes as Col. 36) Col.67______

OTHER CAUSES OF ADMISSION IN 4th YEAR

(Codes as Col. 37) Col.68______ 67 68

PERIOD IN HOSPITAL IN 4th YEAR

000 = None YYY = NA XXX = NK

wks. dys. 69-7

MARITAL STATUS

1 Married 4 Divorced
2 Single X NK
3 Widow 72

CAUSES OF REFERENCE IN THE G.T.T.GROUP

1 Glycosuria e.g. in Routine Exam
2 Glycosuria assoc. with pregnancy
3 Glycosuria assoc. with stress conditions
4 D.M. Symptoms
5 Signs of D.M. or of one of its complications
6 Family History of D.M.
7 Symptoms assoc. with Hypoglycaemia
8 Symptoms assoc. with G.Intest & Liver Diseases 73
9 Glycosuria discovered during insurance Exam
0 Symptoms assoc. with other diseases
Y NA
X NK

RESULTS OF G.T.T.

1 Normal curve 8 Others
2 Renal Glycosuria 0 Not done
3 Diabetic curves Y NA
4 Other Diabetic curves X NK
5 Other Abnormalities
6 Change to Diabetic curve or High B.S. 74
7 Reversion to Normal curve

FORMA 1

Patient No.

Page 7

OTHER DIABETIC CURVE

1 A - High 1 & 2 hours
2 B - High Fasting
3 C - High 2 hour
4 D - High ($\frac{1}{2}$ or/and 1 hour) with high $1\frac{1}{2}$ hour
Y NA
X NK

[ ] 75

OTHER ABNORMALITIES

1 A - High peak with prolon.Hypo.
2 B - High $\frac{1}{2}$ or 1 hour
3 C - Minor "Diabetic" Abnormalities not considered diabetic
4 D - Other Abnormalities "Including Insulinomas"
Y NA
X NK

[ ] 76

YEAR OF DEATH

1 1969	4 1972
2 1970	5 1973
3 1971	O DOPD not notified
	Y NA
	X NK

[ ] 77

Column 78

- Blank if all 3 formas are Coded
- Code 2 if form 2 is missing only
  Code 2 & 3 if both missing

[ ] 78

Column 79

No.of forms for this patient (i.e.1, 2 or 3)

[ ] 79

Card Number 1

[1] 80

Patient Number

1-4

Conditions present at 1st attendance

Diabetic Complications

1 D.Coma and precoma
2 D.Ulcer
3 Retinopathy
4 Inter.Claunication (incl.D.Gang.)
5 Neuropathy
6 Nephtopathy
7 Others
8 None
Y NA
X NK

5

Other Endocrine & Metabolic Diseases

1 Thyroid diseases
2 Dis.of pit.gland
3 Other dis. of end.glands
4 Met.dis. & nut.def.
0 None
Y NA
X NK

6

Hypertensive Diseases & Diseases of Peripheral Vasc.System

1 Hypertension
2 Hypertensive dis.
3 Arteriosclerosis
4 Per.Vasc.dis and Gangrene
5 Pul. emol. & infarc.
6 Phlebitis & thrombophlebitis
7 Var.veins of low ext.
8 Haemorrhoids
0 None
Y NA
X NK

7

Heart Diseases

1 Rheu.heart dis.
2 Acute myo infarc.
3 Other ischaemic heart dis.
4 Congestive card.failure
5 Left.vent.failure
6 Other symp.heart dis.
7 Other forms of heart dis.
0 None
Y NA
X NK

8

Respiratory Diseases

1 Acute resp.inf.(except influenza)
2 Influenza
3 Pneumonia
4 Chronic Bronchitis
5 Emplysema
6 Asthma
7 Other dis.of up resp.tract
8 Other dis.of resp.system (incl.PT.8)
0 None
Y NA
X NK

9

Digestive System Diseases

1 Dis.of oral cav.saliv.gls.& oeso
2 Peptic ulcer
3 Other dis.of oeso.stom.& duodenum
4 Appendicitis
5 Hernia of abdom.cav.
6 Other dis.of intest.& peritoneum
7 Cirrhosis of liver
8 Other dis.of liver
9 Dis.of gall bld.& expan.
0 None
Y NA
X NK

10

FORMA 2

Diseases of Genito-Urinary System

1	Nephritis & Nephrosis	7	Del.without men of comp.	11
2	Urinary tract infts (n.o.c.)	8	Comp.of preg.chbth & the puerperium	
3	Other dis.of urinary system			
4	Dis.of male gen.organs	0	None	
5	Dis.of brst.ov.fall tb.& paramet	Y	NA	
6	Dis.of uterus & oth.fem.gen.organs	X	NK	

Anaemias & Other Haematopaetic Disorders

1	Iron def. ans.	0	None	12
2	Pernicious ans.	Y	NA	
3	Other ans.	X	NK	
4	Other dis.of bld.& bld.frmg.orgs.			

Cerebrovascular Diseases

1	Cerebro vascular accident & its sequele	13
2	Other forms of cerebro vascular dis.	
0	None	
Y	NA	
X	NK	

Diseases of Nervous System, Sensory Organs & Mental Disorders

1	Inflam. dis.of CNS	8	Neurosis,person dis. & oth.nonpsy.men.dis.	14
2	Other dis. of CNS			
3	Dis.of Nerves & periph.ganglia	9	Mental retardations	
4	Inflam.dis.of the eye	0	None	
5	Other dis.& cond.of eye	Y	NA	
6	Dis.of ear & mastoid process	X	NK	
7	Psychosis			

Arthritis & Rheumatism & Diseases of Musculo-skeletal system

1	Acute arth.	6	Other dis.of ms.syst. & conn.tissue dis.	15
2	Rheum.arth.& alld.cond.			
3	Osteoarth.& alld.cond.	0	None	
4	Other frs. of arth. & rheum.	Y	NA	
5	Osteomyelitis & oth.dis.of bn & jts. & orthop.cond.	X	NK	

Neoplasms

1	Mal.neo.of dig.syst.	7	Mal.neo.of oth & unspec.sts.	16
2	" " " pancreas	8	Ben.& unspec.nature neo	
3	" " " resp.syst.	0	None	
4	" " " bn.con.tis.sk.& brst.	Y	NA	
5	" " " gen-ur.organs	X	NK	
6	Neo.of lymph & haema tissue			

Diseases of skin Subcutaneous Tissue

1	Boil and carbuncle	4	Oth.dis.of sk.& cub.tis.	17
2	Cellulites and abscess	0	None	
3	Other infect.& inflam.cond.of sk. & subcut tissue	Y	NA	
		X	NK	

FORMA 2.

Accident and Injuries and Poisoning

1 Fract.of skull,spine & trunk
2 " " up & low limbs
3 Intra inj (ex those with sk frac) & injrs.to nerves & spin cord
4 Oth.injr.frn bdy,burn & psng by chem.subs
0 None
Y NA
X NK

18

Conditions Present as at 31.12.72 (or at time of death)

Diabetic Complications
Code as Col. 5

Other Endocrine & Metabolic Diseases
Code as Col. 6

Hypertensive Diseases & Diseases of Peripheral Vasc.Syst.
Code as Col. 7

19 20 21

Heart Disease
Code as Col.8

Respiratory Diseases
Code as Col.9

Digestive System Diseases
Code as Col. 10

Diseases of Genito-Urinary System
Code as Col.11

22 23 24 25

Anaemias and other Haematopoetic Disorders
Code as Col.12

Cerebrovascular Diseases
Code as Col. 13

Diseases of Nervous System,Sensory organs & Mental Dis.
Code as Col. 14

Arthritis and Rheumatism and Diseases of Musculoskeletal Sys.
Code as Col.15

26 27 28 29

Neoplasms
Code as Col.16

Diseases of skin and Subcutaneous tissue
Code as Col.17

Accidents and Injuries and Poisoning
Code as Col.18

30 31 32

FORMA 2

Education in Insulin Self Regulation

1 As in-patient Y NA
2 As out patient X NK
0 None

33

Diabetes Mellitus or its compls.ment.in Death Certificate

1 Primary cause 4 Not mentioned
2 Underlying cause Y NA
3 Secondary cause X NK

34

Primary cause of Death (from Death Certificate)

1 Diab. Mel. 7 Cerebro-vasc.acc.
2 D.M.comps 8 Pneumonia
3 H.tention & H.tensive Dis. 9 Neoplasms & its comps.
4 Acute myo infarc. & its comps. 0 Other causes
5 Lft.vent failure & R.V.F. Y NA
6 Other cardio-dis. X NK

35

Death occurred in:

1 Hospital Y NA
2 Home X NK
3 Institutions (e.g.OPH & NH)
4 Public Places

36

Card Number

2 80

FORMA 3

Patient No.

NAME:

Patient Number: 1-4

CURRENT AGE AT 31.12.72

Y = NA   X = NK 5-6

PERIOD IN HOSPITAL ONLY
(Within one year from first attendance)

000 = None   YYY = NA   XXX = NK   wks. dys. 7-9

DIFFERENCES IN TIME FOR HOSPITALISATION
(between the statdd period by the patient and that mentioned in the patient case record)

000= None   YYY = NA   XXX = NK   wks. dys. 10-12

CAUSES OF ADMISSION FOR WHICH THE DIFFERENCES ACCOUNT

1 Diabetes and its Complications
2 Diabetes Self Regulation
3 Other Endocrine & Metabolic Diseases
4 Hypertension
5 Heart Diseases
6 Upper Resp. Conditions
7 Other Resp. Conditions
8 Digestive System Diseases
9 Genito-Urinary Diseases
O None
Y NA
X NK

13

OTHER CAUSES FOR ADMISSION

1 Anaemias & other Haemopoetic Disorders
2 Cerebro Vascular Diseases
3 Diseases of the Nervous System, Sensory organs of Mental Disorders
4 Cataract
5 Arthritis and Rheumatism
6 Neoplasms
7 Diseases of the Skin & Subcutaneous Tissue and Phlebitis, Thrombophlebitis & Varicose veins of lower Extremities
8 Accidents and Injuries
9 Others
O None
Y NA
X NK

14

PERIOD IN BED AT HOME (BED DISABILITY)
(Within one year from first attendance)

000 = None YYY = NA XXX = NK

☐☐☐ wks dys. ☐☐☐ 15-17

CAUSES OF BED DISABILITY AT HOME
(Codes as Col.13)

Col.18______

OTHER CAUSES OF BED DISABILITY AT HOME

Col.19______

18 19

SCHOOL-LOSS DAYS
(Within one year from first attendance)

000 = None YYY = NA XXX = NK

☐☐☐ wks. dys. ☐☐ 20-22

WORK-LOSS DAYS
(Within one year from first attendance)

00 = None YYY = NA XXX = NK

☐☐☐ ☐☐☐ 23-25

PERIOD OF LIMITED (RESTRICTED) ACTIVITY
(Within one year from first attendance)

000 = None YYY = NA XXX = NK

☐☐☐ ☐☐☐ 26-28

CAUSES OF LIMITED (RESTRICTED) ACTIVITY
(Codes as Col 13)

Col.29________

OTHER CAUSES OF LIMITED (RESTRICTED) ACTIVITY

Col.30________

29 30

CAUSE OF CHANGE OF JOB

1 Diabetes Mellitus and/or its Complication
2 Other causes.......
0 None
Y NA
X NK

☐ 31

IF OUT OF WORK "UNEMPLOYED", IS IT BECAUSE

1 D.M. and/or its Complication
2 Other causes
0 None
Y NA
X NK

32

DIFFICULTY OF OBTAINING A JOB
WHEN KNOWN TO BE DIABETIC, BECAUSE

1 Diabetes Mellitus
2 Other causes....
0 None
Y NA
X NK

33

VARIABLES NOT MENTIONED IN THE CASE NOTES

1 Marital Status
2 Occupation
3 Chronic illness
4 Hospital admission
0 None
Y NA
X NK

34

CARD/CASE NUMBER CARD 3 3 80

APPENDIX B

Diseases present classified according to Int.Class. of Disease 1965 (8th Revision), List of Three-digit Categories, W.H.O. Geneva

	Detailed list No.
Diabetes and its complications:	250
a. keto-acidosis	
b. Hypoglycaemia	
c. D. Retinopathy	
d. D. gangrene "int. claudication"	
e. Neuropathy	
f. Nephtopahty	
g. Skin infection & Ulcer	
Other Emdocrine and Metabolic Diseases:	
a. Thyroid disease	240 - 246
b. Diseases of other endocrine glands	251 - 258
c. Metabolic diseases (including gout and obesity	260 - 279
Hypertension and diseases of peripheral vascular system	400 - 404 440, 443,445 450, 451, 454 - 455
Heart Diseases	
a. Rh. H.D.	391,393 - 398
b. I.H.D.	410 - 412,414
c. Angina pectoris	413
d. Other forms of H.D.	420 - 429
Upper Resp. Conditions	
a. Acute upper resp. infection	460 - 465
b. Other diseases of upper resp. tract	500 - 508
Other Resp. Conditions	
a. Pulm. T.B.	011
b. Acute Bronchitis and Bronchiotitis	466
c. Influenza	470 - 474
d. Pneumonia	480 - 486
e. Bronchitis, Emphysema and Asthma	490 - 493
f. Other Dis. of resp. system	510 - 519
Diseases of the Digestive System	
a. Diseases of oral cavity, salivory glands and jaws	520 - 529
b. Dis. of oesophagus, stomach and duodenum	530 - 537
c. Appendicitis	540 - 543
d. Hernia of abdominal cavity	550 - 553
e. Other diseases of intestine & peritoneum	560 - 569
f. Dis. of liver, gall bladder & pancreas	570 - 577

	Detailed List No.
Diseases of Genito-Urinary System	
a. Nephritis & Nephrosis	580 - 584
b. Other dis. of Urinary system	590 - 599
c. Dis. of male genital organ (including prostate)	600 - 607
d. Dis. of Breast, ovary, fallopian tubes and parametrium	610 - 616
e. Dis. of uterus and other female genital organs	620 - 629
f. Complications of pregn.	630 - 845
g. Urinary infection and toxaemias of pregn. & puerperium	650 - 662
h. Abortion	640 - 645
i. Delivery	650 - 662
j. Complications of puerperium	670 - 678
Anaemia and other haemopoetic disorders	280 - 289
Cerebro-vascular diseases	430 - 438
Diseases of the nervous system, sensory organs and mental disorders	
a. Inflammatory dis. of C.N.S.	320 - 324
b. Hereditary and familiar dis. of N.S.	330 - 333
c. Other dis. of C.N.S.	340 - 349
d. Dis. of nerves and periph. ganglia	350 - 358
e. Infmallatory dis. of eye	360 - 369
f. Other disease and conditions of the eye	370 - 373
	375 - 379
g. Dis. of ear and mastoid process	380 - 389
h. Psychoses	290 - 299
i. Neuroses, personality disorders and other non-psychotic mental disorders	300 - 309
j. Mental retardation	310 - 315
Cataract	374
Arthritis and Rheumatism	
a. Rheumatic fever (without heart involv.)	390
b. Arthritis and rheumatism	710 - 718
c. Osteomyelitis and other diseases of bone and joints	720 - 729
d. Other dis. of muscular-skeletal system	730 - 738
Neoplasms	
a. Malignant neoplasms.	140 - 159
	160 - 163, 170 - 174, 180 - 199
b. Neoplasms of lymphotic and haemopoetic tissue	200 - 209
c. Benign neoplasms	210 - 228
d. Neoplasms of unspecified nature	230 - 239

	Detailed List No.
Disease of the skin and subcutaneous tissue and some diseases of veins and lymphotics	
a. Infections of skin and cubcutaneous tissue	680 - 686
b. Other inflammatory conditions of skin and sc tissues	690 - 698
c. Other dis. of skin and s.c. tissues	700 - 709
Accidents and Injuries	
a. Fractures	N800 - N829
b. Dislocations without fracture	N830 - N839
c. Sprains and strains of joints and adjacent muscles	N840 - N848
d. Intracranial injury (excluding those with skull fractures)	N850 - N854
e. Internal injury of chest, abdomen and pelvis	N860 - N869
f. Lacerations	N870 - N879, N880 - N887 N890 - N897, N900 - N907
g. Superficial injury	N910 - N918
h. Confusion and crushing with intact skin surface	N920 - N929
i. Effect of foreign body entering through orifice	N930 - N939
j. Burns	N940 - N949
k. Injury to nerves and spinal cord	N950 - N959

APPENDIX C

From: Classification of Occupation, Office of Population Censuses and Surveys, p.IX-X, London, H.M.S.O. 1970.

Classification by Economic Position

The classification by economic position divides the economically active from the inactive and provides further subdivision of these groups as follows:

A. Economically active

1. persons in employment
2. persons out of employment
   a. sick
   b. others

B. Economically inactive

1. retired
2. permanently sick or disabled
3. students in educational establishments
4. other persons economically inactive

The groups are defined as follows:

A. Economically active

1. persons in employment: persons with a paid job or self-employed. Temporary, part-time, or casual employment is included. Persons absent from their employment due to holidays, strikes, lockouts, short time working or temporary stoppage are regarded as in employment. Persons off work sick are regarded

as "In employment" if their job is waiting for them on their return. Unpaid employment in a family business is included.

2. persons out of employment

persons without a paid job.

a. sick

persons temporarily prevented from seeking work because of sickness.

b. other

persons seeking work or waiting to take up a job.

B. <u>Economically inactive</u>

1. retired: formerly occupied persons who have ceased working and are no longer seeking further employment. Females engaged on unpaid domestic duties even though previously employed and treated as "other economically inactive".

2. permanently sick or disabled persons, whether or not previously in employment, not now seeking employment because of permanent sickness or disability. Persons who have spent more than six months in a chronic sick or psychiatric hospital and are returned as out of employment are included.

3. students in educational establishments. Persons aged 15 and over who ar e or will be attending full time at an educational establishment during next term.

a. those with a paid job

b. those without a paid job.

4. others economically inactive. All persons who

have never been in employment and are now seeking employment, and those who have spent more than six months in a prison, and are returned as out of employment. Persons of independent means or engaged entirely on unpaid domestic duties even though they may have had paid work at some time are included.

Social Class Classifications

Social Class	1	Professional, etc., occupations
	II	Intermediate occupations
	III	Skilled occupations
		(N) Non-manual
		(M) Manual
	IV	Partly skilled occupations
	V	Unskilled occupations

Detailed allocation of occupation/employment status of diabetics to the five social classes was done according to list appearing in "Classification of Occupation", Appendix B.1: (Socio-economic group and social class allocations of occupation and employment status groups.)

Table 1: Causes of referral of 455 "G.T.T." patients by age and sex

Causes of referral	All ages			<20		20-39		40-59		60-79		80+	
	B	M	F	M	F	M	F	M	F	M	F	M	F
Gly. in medical examination	251	169	82	11	9	47	26	67	26	40	21	4	0
Gly. in pregnancy	33	0	33	0	2	0	30	0	1	0	0	0	0
Gly. & stress condition	55	32	23	2	1	5	6	11	5	14	11	0	0
D.M.symptoms	81	39	42	4	2	8	11	10	14	17	15	0	0
Sign of D.M. or its complication	9	2	7	0	0	0	1	0	3	2	3	0	0
Family history	51	26	25	7	3	6	9	8	6	4	7	1	0
Hypogly.symptoms	23	16	7	2	2	2	2	10	2	2	1	0	0
G.I. and liver dis.symptoms	20	17	3	0	0	6	1	6	2	5	0	0	0
Gly.in insurance exam.	38	34	4	0	0	8	2	23	1	3	0	0	1
Symptoms of other diseases	43	21	22	1	1	2	2	11	11	7	8	0	0
Number of patients	455	278	177	21	15	71	70	115	48	67	43	4	1

M = Male

F = Female

B = Both sexes

Table 2 : Results of Glucose Tolerance Tests according to causes of referral

Results of G.T.T.	All causes No.	All causes %	Glycosuria on medical examination	Glycosuria in pregnancy	Glycosuria with stress condition	D.M. symptoms	Sign of D.M. complication	Family history of D.M.	Hypoglycaemic symptoms	G.I. & liver diseases symptoms	Glycosuria in insurance exam.	Symptoms of other Diseases
	M A L E S											
Normal curve	93	33.5	54	-	8	13	1	9	12	3	6	9
Renal Glyc.	81	29.1	50	-	14	8	-	4	1	3	14	1
D. curve	21	7.5	11	-	3	5	-	2	1	2	3	1
D.abnormalities	43	15.5	27	-	7	7	1	7	-	1	6	6
Other abnormal-ities	40	14.4	27	-	-	6	-	4	2	8	5	4
Total	278	100.0	169	-	32	39	2	26	16	17	34	21
Change to Diab. Curve	2		2	-	-	-	-	1	-	-	-	-
Reversion to Normal	2		2	-	-	1	-	-	-	-	-	1
	F E M A L E S											
Normal curve	72	40.7	38	5	3	10	5	12	6	2	3	12
Renal Glyc.	42	23.7	13	27	1	9	-	2	-	-	-	2
D. curve	26	14.7	15	-	3	14	2	7	-	-	1	2
Diab.abnormal-ities	23	13.0	10	-	12	6	-	3	-	-	-	3
Other abnormal-ities	14	7.9	6	1	4	3	-	1	1	1	-	3
Total	177	100.0	82	33	23	42	7	25	7	3	4	22
Change to Diab Curve	1		-	-	1	-	-	-	-	-	-	-
Reversion to Normal	-		-	-	-	-	-	-	-	-	-	-

Table3 : Types of Glucose Tolerance Curve in 66 patients with "Diabetic abnormality" and in other 54 patients with "other abnormalities"

Type of G.T.T.	All ages	<40	40-59	60+
	Type of Curve in 66 patients with "diabetic abnormality"			
High 1 and 2 hour	54	1	21	32
High fasting	0	0	0	0
High 2 hour	8	3	1	4
High $\frac{1}{2}$ and/or 1 hour and $1\frac{1}{2}$ hour	4	0	1	3
Type of G.T.T.	Type of Curve in 54 patients with "other abnormalities"			
High $\frac{1}{2}$ or 1 hour with hypoglycaemia	3	2	1	0
High $\frac{1}{2}$ or 1 hour	45	17	19	9
Not significant "minor deviations"	6	0	2	4

Table 4:

17 patients with duration between onset and diagnosis of more than a year, by age and sex at diagnosis

Age at diagnosis	1 year		2 years		3-4		5-9		10+		All duration		
	M	F	M	F	M	F	M	F	M	F	M	F	Both
30-39	0	1	0	0	0	0	1	0	0	0	1	1	2
40-59	0	2	1	0	0	0	0	0	0	0	1	2	3
60-79	2	3	1	1	1	1	0	0	0	1	4	6	10
80+	0	0	0	0	0	1	0	0	1	0	1	1	2
All ages	2	6	2	1	1	2	1	0	1	1	7	10	17

Table 5:

Status of Patients at 31.12.72, according to duration of diabetes, by sex, 1969-71

Year of first Attendance	No "Duration"			DURATION* IN YEARS										All Durations		
				1		2		3-4		5-9		10+				
	Both	M	F	M	F	M	F	M	F	M	F	M	F	M	F	Both
1969																
Alive	161	79	82	0	1	2	5	1	2	5	3	4	3	12	14	26
Defaulted	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Dead	25	13	12	0	1	0	0	1	1	0	1	0	4	1	7	8
1970																
Alive	200	90	110	1	1	2	1	2	3	5	2	6	3	16	10	26
Defaulted	4	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Dead	35	20	15	1	0	0	0	1	2	0	0	0	0	2	2	4
1971																
Alive	220	83	137	0	1	1	0	4	4	5	4	8	9	18	18	36
Defaulted	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Dead	21	8	13	0	0	0	0	0	0	0	1	2	0	2	1	3

*"Duration" in years, since diagnosis till first attendance

Table 6: Distribution of patients according to year of diagnosis per age and sex from all hospitals

Hospital and Year of Diagnosis	All ages			< 10		< 20		< 30		< 40		< 50		< 60		< 70		< 80		80+	
	M	F	Both	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
W.G.H.																					
1969	15	22	37	-	-	1	-	-	-	1	1	2	3	3	4	6	7	2	7	-	-
1970	16	13	29	-	-	-	-	1	1	-	1	3	-	1	3	6	4	3	3	2	1
1971	25	30	55	1	1	1	3	2	2	1	3	1	1	7	4	6	9	4	7	3	1
Leith Hosp.																					
1969	9	9	18	-	-	-	-	-	1	-	-	1	1	-	3	5	2	3	2	-	-
1970	11	5	16	-	-	2	1	-	-	1	-	1	-	-	-	6	2	-	2	1	-
1971	10	6	16	-	-	-	-	-	-	-	-	2	1	6	-	-	4	2	1	-	-
R.H.S.C.																					
1969	4	2	6	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1970	5	4	9	3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1971	3	4	7	2	2	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chalmers Hosp.																					
1969	2	5	7	-	-	-	-	-	-	-	-	-	1	-	-	1	3	-	1	1	-
1970	4	4	8	-	-	-	-	-	-	-	-	1	-	1	1	2	2	-	1	-	-
1971	5	1	6	-	-	-	-	-	-	-	-	-	1	1	-	3	-	-	-	1	-
E.G.H.																					
1969	4	2	6	-	-	-	-	-	-	-	-	-	-	2	1	1	-	1	1	-	-
1970	5	6	11	-	-	-	-	-	-	-	-	1	-	2	2	-	2	2	2	-	-
1971	7	4	11	-	-	-	-	1	-	-	-	-	-	1	-	4	2	1	1	-	1
Bruntsfield Hosp.																					
1969	0	1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
1970	0	2	2	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-
1971	0	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2	-	-
Longmore Hosp.																					
1969	0	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
1970	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
1971	0	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Deaconess Hosp.																					
1969	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-
1970	0	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-
1971	0	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
N.G.H.																					
1969	1	3	4	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	1	-	-
1970	0	1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
1971	3	3	6	-	-	-	-	-	-	-	-	-	-	-	-	1	2	2	-	-	1
City Hosp.																					
1969	1	0	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
1970	1	2	3	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-	-
1971	1	3	4	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	1	-	1

F = Female M = Male B = Both sexes

Liberton, Southfield, Loanhead and Royal Victoria Hospitals and Dispensary, no newly diagnosed diabetics during 1969-71 period.

T.7
Status of 775 patients at 31.12.72, according to year of first attendance by age and sex

Year of first Attendance	All Ages Both	M	F	AGE AT DIAGNOSIS 0-9 M	F	10-19 M	F	20-29 M	F	30-39 M	F	40-49 M	F	50-59 M	F	60-69 M	F	70-79 M	F	80+ M	F
1969																					
Alive	187	91	96	4	1	6	4	9	2	5	4	7	10	11	17.	31-	40	15	15	3	3
Defaulted	4	3	1	0	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0	0	0
Dead	33	14	19	0	0	0	0	0	1	1	1	0	2	2	1	4	8	4	6	3	0
1970																					
Alive	226	106	120	3	1	8	6	4	3	6	6	13	15	25	23	34	36	10	23	3	7
Defaulted	4	2	2	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	1
Dead	39	22	17	0	0	0	0	0	0	0	1	0	0	1	1	12	6	8	7	1	2
1971																					
Alive	256	101	155	1	3	10	11	5	4	6	4	18	13	29	30	25	53	6	32	1	5
Defaulted	2	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Dead	24	10	14	0	0	0	0	0	0	0	0	2	1	2	1	3	3	3	8	0	1

T. 8: Distribution of patients first seen in the clinic in 1969, 1970 and 1971 according to duration of diabetes by age and sex.

	Patients first attended 1969							Patients first attended 1970							Patients first attended 1971						
Duration	No dur.	1yr	2 yrs	3-4yrs	5-9yrs	10+	Total with dur.	No dur.	1yr	2yrs	3-4yrs	5-9yrs	10+	Total with dur.	No dur.	1yr	2yrs	3-4yrs	5-9yrs	10+	Total with dur.
Age								M A L E S													
All ages	95	0	2	2	5	4	13	112	2	2	3	5	6	18	92	0	1	4	5	10	20
<20	5	0	0	0	3	2	5	7	0	0	0	2	2	4	2	0	0	0	0	2	2
20 - 39	12	0	1	0	2	0	3	9	0	0	0	0	2	2	6	0	0	0	2	3	5
40 - 59	21	0	0	0	0	1	1	32	1	1	1	2	2	7	42	0	0	3	2	5	10
60 - 79	51	0	1	2	0	1	4	61	1	1	1	1	0	4	34	0	1	1	1	0	3
80+	6	0	0	0	0	0	0	3	0	0	1	0	0	1	1	0	0	0	0	0	0
								F E M A L E S													
All ages	95	2	5	3	4	7	21	127	1	1	5	2	3	12	151	1	0	4	5	9	19
<20	2	0	0	0	1	2	3	5	0	0	1	0	1	2	8	0	0	0	2	4	6
20-39	6	0	0	0	2	0	2	9	0	1	0	0	1	2	7	0	0	1	0	0	1
40-59	23	0	1	1	0	5	7	37	0	0	0	1	1	2	39	1	0	0	1	4	6
60-79	61	2	4	2	1	0	9	66	1	0	4	1	0	6	91	0	0	3	2	1	6
80+	3	0	0	0	0	0	0	10	0	0	0	0	0	0	6	0	0	0	0	0	0

Table 9. Initial and established treatment by age and sex (775 patients)

Treatment	<20 Init.	<20 Estab.	20-39 Init.	20-39 Estab.	40-59 Init.	40-59 Estab	60-79 Init.	60-79 Estab	80+ Init.	80+ Estab.
	M A L E S									
Insulin	30	32	28	28	4	11	2	2	0	1
Oral	0	0	1	4	27	42	47	85	6	4
Diet	2	0	8	5	82	60	108	70	5	6
	F E M A L E S									
Insulin	24	25	17	18	10	14	9	9	0	0
Oral	1	0	2	5	31	55	94	157	5	13
Diet	1	1	8	4	73	45	136	73	14	6

TABLE 10

Established Treatment according to duration in 775 patients 1969-71

Treatment	MALES				FEMALES			
	"No Duration"		"Duration"		"No Duration"		"Duration"	
	No.	%	No.	%	No.	%	No.	%
Insulin	118	16.1	26	51.0	42	11.3	24	46.2
Oral	114	38.1	21	41.2	206	55.2	24	46.2
Diet	137	45.8	4	7.8	125	33.5	4	7.6
Total	299		51		373		52	

Table 11: Insulin dosage in 140 insulin-dependent patients

Treatment	< 20		20-39		40-59		60-79		80+	
	No Dur.	Dur.	No. Dur.	Dur.	No Dur.	Dur.	No Dur.	Dur.	No Dur.	Dur.
			M A L E S							
<40 units	13	6	11	2	4	2	0	0	0	0
40+ units	8	5	7	8	3	2	2	0	0	1
			F E M A L E S							
<40 units	7	1	9	5	3	3	3	0	0	0
40+ units	7	10	4	0	4	4	5	1	0	0

Table 12: Distribution of 775 patients according to weight as percentage of standard weight and according to "duration" at their first attendance

Weight as per cent standard weight	"No Duration"		"Duration"	
	Males	Females	Males	Females
< 90	39	87	11	7
90-	71	70	14	15
100-	72	79	11	10
110-	42	54	9	8
120+	72	79	6	10
N.K.	3	4	0	2
	299	373	51	52

Table 13: Marital status of 775 patients, according to age and sex

Marital Status	< 20	20-29	30-39	40-49	50-59	60-69	70-79	80+
M A L E S								
Married	1	7	15	31	55	80	26	5
Single	31	11	4	5	4	10	2	-
Widowed	-	-	-	1	4	13	15	6
Divorced	-	-	-	1	-	-	-	-
Unknown	-	-	-	4	8	8	3	-
F E M A L E S								
Married	5	6	12	31	46	74	21	3
Single	21	4	2	5	11	19	17	3
Widowed	-	-	-	4	12	45	48	12
Divorced	-	-	-	-	-	-	1	-
Unknown	-	1	2	1	4	9	5	1

Table 14: Distribution of patients according to social class, by age and sex

Social Class	<20	20-29	30-39	40-49	50-59	60-69	70-79	80+
				M A L E S				
I	-	1	2	3	6	3	3	1
II	1	4	2	9	16	7	4	1
III	6	10	10	20	31	63	16	4
IV	-	-	2	5	8	19	10	2
V	-	-	2	3	2	6	-	-
Unknown and un-classified	25	3	1	2	8	13	13	3
				F E M A L E S				
I	1	1	1	1	2	3	1	-
II	1	2	4	7	9	16	19	1
III	6	6	6	15	26	49	37	5
IV	1	-	2	7	8	30	4	3
V	-	1	-	7	10	7	7	1
Unknown and un-classified	17	1	3	4	18	42	24	9

Table[15]: Occupation of 775 patients by age and sex

Occupation	<20	20-29	30-39	40-49	50-59	60-69	70-79	80+	All ages No.	All ages % of known
					MALES					
Manual	2	7	10	19	26	35	-	-	99	29.7
Non-manual	4	8	8	17	28	21	4	-	90	27.0
Student	24	1	-	-	-	-	-	-	25	7.5
Unemployed	1	1	-	4	5	1	-	-	12	3.6
Retired	-	1	-	1	5	49	39	10	105	31.5
Other economically inactive	1	-	-	-	1	-	-	-	2	0.6
Unknown	-	-	1	1	6	5	3	1	17	
					FEMALES					
Manual	1	1	-	9	12	5	2	-	30	8.1
Non-manual	7	7	5	10	14	15	3	-	61	16.5
Housewife	1	2	8	16	31	93	54	9	214	58.0
Student	15	-	-	-	-	-	-	-	15	4.1
Unemployed	-	-	-	2	2	-	-	-	4	1.1
Retired	-	-	-	1	3	13	20	4	41	11.1
Other economically inactive	-	1	-	-	-	2	1	-	4	1.1
Unknown	2	-	3	3	11	19	12	6	56	

TABLE 16

Causes of change of job in 9 patients

Occupation	MALES			FEMALES		
	Diabetes	Other causes	No change	Diabetes	Other causes	No change
Manual	2	2	24	0	0	5
Non-Manual	0	3	29	1	1	26
Total	2	5	53	1	1	31

Causes of Difficulty encountered by 3 patients when seeking a job.

Occupation	MALES			FEMALES		
	Diabetes	Other causes	No difficulty	Diabetes	Other causes	No difficulty
Manual	2	0	27	0	0	5
Non-Manual	0	0	32	1	0	26
Total	2	0	58	1	0	32

Causes of Unemployment in 11 patients

Type of Diabetes	MALES			FEMALES		
	Diabetes	Other causes	In Employment	Diabetes	Other causes	In Employment
Insulin-Dependent	0	1	12	0	0	15
Insulin Independent	1	5	48	0	4	18
Total	1	6	60	0	4	33

Table 17: Diabetes complications present at first attendance, 765 patients, by sex and age at first attendance

Diabetes Complications	"NO DURATION						"DURATION					
	<20	20-39	40-59	60-79	80+	All ages	<20	20-39	40-59	60-79	80+	All ages
	MALES											
Coma & Precoma	1	4	0	3	0	8	1	1	0	0	0	2
Foot ulcer	0	0	0	0	0	0	0	0	0	0	0	0
Retinopathy	0	1	1	4	0	6	0	5	3	0	0	8
Int.claud. incl.gangrene	0	1	0	2	0	3	0	0	2	1	0	3
Neuropathy	1	1	1	5	0	8	0	2	2	0	0	4
Nephropathy	0	0	0	2	0	2	1	0	1	0	0	2
Patients with complications	1	4	2	9	0	16	2	6	5	1	0	14
Patients without complications	20	22	90	135	10	277	9	4	13	10	1	37
Total patients	21	26	92	144	10	293	11	10	18	11	1	51
Complications	FEMALES											
Coma & precoma	1	1	1	6	1	10	1	0	1	0	0	2
Foot ulcer	0	0	0	0	0	0	0	0	.0	1	0	1
Retinopathy	0	0	1	6	0	7	0	3	2	5	0	10
Int.claud. incl.gangrene	0	0	2	4	0	6	0	0	3	0	0	3
Neuropathy	0	0	1	4	1	6	0	0	0	0	0	0
Nephropathy	0	0	0	0	0	0	0	0	1	0	0	1
Patients with complications	1	1	4	17	2	25	1	3	4	6	0	14
Patients without complications	14	20	95	199	16	344	10	2	11	15	0	38
Total patients	15	21	99	216	18	369	11	5	15	21	0	52

Table 18 : Diabetes complications present at end of observation period, 765 patients by sex and age at first attendance (31.12.72)*

Diabetes Complications	"NO DURATION"						"DURATION"					
	<20	20-39	40-59	60-79	80+	All ages	<20	20-39	40-59	60-79	80+	All ages
	M A L E S											
Coma & Precoma	0	0	0	0	0	0	0	0	0	1	0	1
Foot Ulcer	0	0	0	1	0	1	0	0	0	0	0	0
Retinopathy	0	1	6	11	0	18	0	5	3	0	0	8
Int.claid. incl.gangrene	0	1	1	3	0	5	0	0	2	1	0	3
Neuropathy	2	2	6	13	0	23	0	2	2	0	0	4
Nephropathy	0	1	0	2	0	3	1	0	1	0	0	2
Patients with complications	2	3	11	21	0	37	1	6	6	1	0	14
Patients without complications	19	23	81	123	10	256	10	4	12	10	1	37
Total patients	21	26	92	144	10	293	11	10	18	11	1	51
Complications	F E M A L E S											
Coma & Precoma	0	0	0	0	0	0	0	0	0	1	0	1
Foot ulcer	0	0	0	2	0	2	0	0	0	1	0	1
Retinopathy	1	0	4	19	0	24	0	3	2	6	0	11
Int.Claud. incl.gangrene	0	0	3	6	0	9	0	0	3	0	0	3
Neuropathy	0	0	3	11	1	15	0	0	0	1	0	1
Nephropathy	0	0	0	1	0	1	0	0	1	0	0	1
Patients with Complications	1	0	8	33	1	43	0	3	4	8	0	15
Patients without complications	14	21	91	183	17	326	11	2	11	13	0	37
Total patients	15	21	99	216	18	369	11	5	15	21	0	52

* including complications present at time of death in those who died.

<u>Table 19</u>: Duration of Proteinuria in 775 patients, by sex and age at first attendance

	"NO DURATION"						"DURATION"					
	<20	20-39	40-59	60-79	80+	All ages	<20	20-39	40-59	60-79	80+	All ages
	M A L E S											
Consistently absent	18	20	88	129	10	265	10	9	14	9	1	43
Intermittently mild	3	4	5	10	0	22	0	1	1	2	0	4
Consistently mild/moderate	0	3	2	5	0	10	1	0	2	0	0	3
Consistently severe	0	0	0	2	0	2	0	0	1	0	0	1
Not known	0	0	0	0	0	0	0	0	0	0	0	0
Total	21	27	95	146	10	299	11	10	18	11	1	51
	F E M A L E S											
Consistently absent	13	16	90	201	16	336	10	5	14	21	0	50
Intermittently mild	0	5	4	9	3	21	1	0	0	0	0	1
Consistently mild/moderate	1	1	3	4	0	9	0	0	1	0	0	1
Consistently severe	1	0	2	3	0	6	0	0	0	0	0	0
Not known	0	0	0	1	0	1	0	0	0	0	0	0
Total	15	22	99	218	19	373	11	5	15	21	0	52

Table 20: Distribution of Heart Diseases in 765 patients at first attendance by sex and age at first attendance

Heart Disease*	"NO DURATION"						"DURATION					
	<20	20-39	40-59	60-79	84+	All ages	<20	20-39	40-59	60-79	80+	All ages
	M A L E S											
Rh. Heart disease	0	0	0	1	0	1	0	0	0	0	0	0
Acute Myo.Infarction	0	0	2	5	0	7	0	0	1	0	0	1
Other Isch.H.Disease	0	0	12	29	1	42	0	0	3	2	0	5
Cong.Cardiac failure	0	0	1	12	1	14	0	0	1	2	1	4
Left Vent. failure	0	0	0	4	0	4	0	0	0	0	0	0
Other Sympt.Heart Dis.	0	0	1	0	0	1	0	0	1	0	0	1
Other forms of H.D.	0	0	0	0	0	0	0	0	0	0	0	0
No. of patients with Heart Disease	0	0	14	39	2	55	0	0	4	3	1	8
Total number of patients	21	26	92	144	10	293	11	10	18	11	1	51
	F E M A L E S											
Rh. Heart Disease	0	0	3	8	1	12	1	0	0	0	0	1
Acute Myo.Infarction	0	0	1	4	1	6	0	0	0	0	0	0
Other Isch.H.Disease	0	0	6	35	3	44	0	0	3	3	0	6
Cong.Cardiac failure	0	0	3	28	6	37	0	0	1	4	0	5
Left Vent.failure	0	0	1	7	0	8	0	0	1	0	0	1
Other Sympt.Heart Dis.	0	0	2	4	0	6	0	0	0	0	0	0
Other forms of H.D.	0	1	0	2	0	3	0	0	0	0	0	0
No.of patients with Heart Disease	0	1	10	66	9	86	1	0	4	6	0	11
Total number of patients	15	21	99	216	18	369	11	5	15	21	0	52

*The diagnosis was based on clinical, biochemical and electrocardiographic evidence of past infarction or chest pain which led the physician to diagnose angina, and the diseases were classified:

Heart Disease	I.C.D.Numbers
Rheumatic Heart Disease	391, 393-398
Acute Myocardial Infarction	410
Other Ischaemic Heart Disease	411-414
Congestive Cardiac Failure	427.0
Left Ventricular Failure	427.1
Other Symptomatic Heart Disease	427.2, 427.9
Other forms of Heart Disease	420-426 428-429

Table 21: Distribution of Heart Diseases in 765 patients at end of observation period* by sex and age at first attendance

Heart Diseases	"NO DURATION"						"DURATION"					
	<20	20-39	40-59	60-79	80+	All ages	<20	20-39	40-59	60-79	80+	All ages
M A L E S												
Rh.Heart Diseases	0	0	0	1	0	1	0	0	0	0	0	0
Acute Myo. Infarction	0	0	2	16	1	19	0	0	3	0	0	3
Other Isch.H. Dis.	0	0	15	32	2	49	0	1	5	2	0	8
Cong.Card.Failure	0	0	1	13	1	15	0	0	1	2	1	4
Left Vent.Failure	0	0	0	4	0	4	0	0	0	0	0	0
Other Sympt.H.Dis.	0	0	3	0	0	3	0	0	0	0	0	0
Other forms of H.D.	0	0	0	0	0	0	0	0	0	0	0	0
No. of Patients with Heart Diseases	0	0	18	50	3	71	0	1	6	3	1	11
Total Number of Patients	21	26	92	144	10	293	11	10	18	11	1	51
F E M A L E S												
Rh.Heart Disease	0	0	4	8	1	13	1	0	0	0	0	1
Acute Myo.Infarction	0	0	1	7	2	10	0	0	0	1	0	1
Other Isch.H.Disease	0	0	7	42	5	54	0	0	3	3	0	6
Cong.Card.Failure	0	0	3	29	6	38	0	0	1	4	0	5
Left Vent.Failure	0	0	2	5	0	7	0	0	1	0	0	1
Other Sympt.H.Dis.	0	0	3	4	0	7	0	0	0	0	0	0
Other forms of H.D.	0	1	0	2	0	3	0	0	0	0	0	0
No. of Patients with Heart Diseases	0	1	12	72	9	94	1	0	4	6	0	11
Total Number of Patients	15	21	99	216	18	369	11	5	15	21	0	52

*including conditions present in dead patients at time of death.

Table 22: Distribution of Hypertensive Diseases and Diseases of Peripheral Vascular System in 765 patients at first attendance by sex and age

Diseases*	"NO DURATION"						"DURATION"					
	<20	20-39	40-59	60-79	80+	All ages	<20	20-39	40-59	60-79	80+	All ages
						M A L E S						
Hypertension	0	0	14	21	1	36	0	0	2	2	0	4
Hypertensive Disease	0	0	0	2	0	2	0	0	1	0	0	1
Arteriosclerosis	0	0	1	15	3	19	0	0	0	2	0	2
Per.Art. Dis. & Gangrene	0	1	2	7	0	10	0	0	0	0	0	0
Pulm. Embol. & Infarction	0	0	1	0	0	1	0	0	0	1	0	1
Phlebitis & Thrombophlebitis	0	0	1	2	0	3	0	0	0	0	0	0
Varicose veins	0	0	0	3	0	3	0	0	0	1	0	1
Haemorrhoids	0	0	0	1	0	1	0	0	0	0	0	0
Number of patients with diseases	0	1	17	40	4	62	0	0	2	4	0	6
Total number of patients	21	26	92	144	10	293	11	10	18	11	1	51
						F E M A L E S						
Hypertension	0	0	13	36	4	53	0	0	0	7	0	7
Hypertensive diseases	0	0	3	4	0	7	0	0	0	0	0	0
Arteriosclerosis	0	0	0	12	1	13	0	0	0	4	0	4
Per. Vas.Dis. & Gangrene	0	0	0	3	1	4	0	0	0	1	0	1
Pulm. Emb. & Infarction	0	0	0	2	0	2	0	0	1	0	0	1
Phlebitis & Thrombophlebitis	0	0	0	3	0	3	0	0	1	1	0	2
Varicose veins	0	0	3	4	2	9	0	0	0	1	0	1
Haemorrhoids	0	0	2	2	0	4	0	0	1	0	0	1
Number of patients with Diseases	0	0	15	53	7	75	0	0	2	11	0	13
Total Number of patients	15	21	99	216	18	369	11	5	15	21	0	52

* Classified according to I.C.D., 8th Revision

Hypertension	400-401
Hypertensive Diseases	402-404
Arteriosclerosis	440
Per.Arterial Dis. & Gangrene	443, 445
Pulmonary Embolism & Infarction	450
Phlebitis & Thrombophlebitis	451
Varicose veins of lower extremities	454
Haemorrhoids	455

Table 23: Distribution of hypertensive diseases and diseases if peripheral vascular system in 765 patients at end of observation period* by sex and age at first attendance

	"NO DURATION"						"DURATION"					
	<20	20-39	40-59	60-79	80+	All ages	<20	20-39	40-59	60-79	80+	All ages
M A L E S												
Hypertension	0	0	15	21	1	37	0	0	2	2	0	4
Hypertensive Diseases	0	0	0	2	0	2	0	0	1	0	0	1
Arteriosclerosis	0	0	1	16	3	20	0	0	0	2	0	2
Per.Art.Dis. & Gangrene	0	1	2	8	0	11	0	0	0	0	0	0
Pulm.Embolism & Infarction	0	0	1	1	0	2	0	0	0	1	0	1
Phlebitis & Thrombophlebitis	0	0	1	1	0	2	0	0	0	0	0	0
Varicose veins	0	0	0	3	0	3	0	0	0	1	0	1
Haemorrhoids	0	0	0	1	0	1	0	0	0	0	0	0
Number of patients with Diseases	0	1	18	41	4	64	0	0	2	4	0	6
Total number of patients	21	26	92	144	10	293	11	10	18	11	1	51
F E M A L E S												
Hypertension	0	0	14	38	4	56	0	0	0	7	0	7
Hypertensive Diseases	0	0	3	4	0	7	0	0	0	0	0	0
Arteriosclerosis	0	0	0	12	1	13	0	0	0	4	0	4
Per.Vas.Dis. & Gangrene	0	0	0	3	1	4	0	0	0	1	0	1
Pulm.Embolism & Infarction	0	0	0	2	0	2	0	0	0	0	0	0
Phlebitis & Thrombophlebitis	0	0	0	1	0	1	0	0	0	2	0	2
Varicose Veins	0	0	3	3	1	7	0	0	0	2	0	2
Haemorrhoids	0	0	2	0	0	2	0	0	1	0	0	1
Number of Patients with Diseases	0	0	16	52	6	74	0	0	1	11	0	12
Total number of patients	15	21	99	216	18	369	11	5	15	21	0	52

*including conditions present in dead patients at time of death

Table 24: Diseases associated with diabetes, present at first attendance, in 775 patients by sex and age at first attendance

Diseases and Conditions present at first attendance	"NO DURATION"								"DURATION"							
	MALES				FEMALES				MALES				FEMALES			
	<40	40-59	60+	All ages	<40	40-59	60+	All ages	<40	40-59	60+	All ages	<40	40-59	60+	All ages
Cataract	0	3	16	17	0	2	41	43	0	2	5	7	0	4	4	8
Thyroid Disease	0	2	0	2	1	5	10	16	0	1	0	1	0	2	1	3
Pernicious Anaemia	0	0	3	3	0	1	8	9	0	0	0	0	0	1	0	1
Ischaemic Heart Dis.	0	12	32	44	0	5	44	49	0	3	2	5	0	2	3	5
Per.Art.Dis. and Arteriosclerosis	1	3	18	22	0	0	11	11	0	0	1	1	0	0	3	3
Long term Steroid Therapy	1	1	3	5	1	5	12	18	0	1	0	1	0	0	0	0
Carcinoma of Pancreas	0	0	3	3	0	1	2	3	0	0	0	0	0	0	0	0
Other causes of Secondary Diabetes	0	0	0	0	1	1	0	2	0	0	0	0	0	0	0	0
Number of patients with disease	2	20	60	82	2	19	112	133	0	7	8	15	0	7	9	16
Per cent of Patients with Disease	4.2	21.1	38.5	27.4	5.4	19.2	47.3	35.7	-	38.9	66.7	29.4	-	46.7	42.9	30.8
Total Number of Patients	48	95	156	299	37	99	237	373	21	18	12	51	16	15	21	52

Table 25 : Respiratory Diseases among 662 newly diagnosed diabetics at time of diagnosis and at the end of the observation period, according to sex and age groups

Respiratory Diseases*	MALES				FEMALES			
	First Attend.		End of Period		First Attend		End of Period	
	<60	60+	<60	60+	<60	60+	<60	60+
Acute Respiratory Infection	1	0	0	0	3	1	0	0
Influenza	0	0	0	1	0	0	0	2
Pneumonia	2	2	0	6	2	1	0	7
Chronic Bronchitis	5	15	5	15	1	10	1	10
Emphysema	1	3	1	3	0	1	0	1
Asthma	1	3	1	3	5	7	5	7
Other dis.of upper respiratory tract	1	1	0	0	2	0	1	0
Other dis.of respiratory system	3	2	4	2	0	2	0	2
Number of patients with respiratory disease	12	22	9	25	13	18	7	25
Per cent of total	8.6	14.3	6.6	16.2	9.6	7.7	5.2	10.7
Total number of patients	139	154	139	154	135	234	135	234

*Diseases were classified according to Int.Class.of Diseases, 8th Revision, (1965):

Diseases	I.C.D.Detailed List No.
Acute Respiratory Infection	460-466
Influenza	470-474
Pneumonia	480-486
Chronic Bronchitis	490-491
Emphysema	492
Asthma	493
Other Diseases of Upper Respiratory Tract	500-508
Other Diseases of Respiratory System	510-519

Table 26 : Digestive System diseases among 662 newly diagnosed diabetics at time of diagnosis and end of observation period, according to sex and age group

Digestive System Diseases*	MALES				FEMALES			
	First Attend.		End of Period		First Attend.		End of Period	
	<60	60+	<60	60+	<60	60+	<60	60+
Dis.of oral cavity, saliv. gland & oesophagus	0	0	0	0	0	0	0	0
Peptic Ulcer	2	9	2	9	3	2	3	2
Other dis. of oesoph., stomach & duodenum	0	0	0	0	1	0	0	0
Appendicitis	2	1	0	0	1	0	0	0
Hernia of abdominal cavity	2	7	0	5	3	8	1	8
Other dis. of intestine and peritoneum	2	1	2	0	0	4	1	3
Cirrhosis of liver	4	1	4	1	0	2	0	2
Other disease of liver	2	2	1	2	0	0	0	0
Dis. of gall bladder and exocrine pancreas	2	0	3	0	4	9	2	4
Number of patients with digestive system diseases	15	21	11	16	11	23	6	17
Per cent of total patients	10.8	13.6	7.9	10.4	8.2	9.8	4.5	7.3
Total number of patients	139	154	139	154	135	234	135	234

*Classification according to International Classification of Diseases, 8th Revision, 1965.

Diseases	I.C.D.List No.
Diseases of oral cavity, salivary glands and oesaphohagus	520-530
Peptic ulcer (Stomach & Duodenum)	531-533
Other diseases of oesophagus, stomach and duodenum	534-537
Appendicitis	540-543
Hernia of abdominal cavity	550-553
Other diseases of intestine and peritoneum	560-569
Cirrhosis of liver	571
Other diseases of liver	570, 572, 573
Diseases of gall bladder & exocrine pancreas	574-577

Table 27 : Genito-Urinary System diseases among 662 newly diagnosed diabetics at time of diagnosis and end of observation period, according to sex and age groups

Genito-Urinary System Diseases*	MALES				FEMALES			
	First Attend.		End of Period		First Attend.		End of Period	
	<60	60+	<60	60+	<60	60+	<60	60+
Nephritis & Nephrosis	3	2	2	2	1	2	1	2
Urinary Tract Infections (N.O.C.)	1	4	0	0	7	13	0	3
Other Dis.of Urinary System	1	2	1	3	2	0	2	0
Dis.of male Genital Organs	4	12	2	7	0	0	0	0
Dis.of Breast, Ovary, Fallopian Tube and Parametrium	0	0	0	0	1	0	1	0
Dis.of Uterus & other female Genital Organs	0	0	0	0	4	8	2	6
Delivery without mention of complications	0	0	0	0	1	0	0	0
Complications of preg. childbirth and the puerperium	0	0	0	0	3	0	0	0
Number of patients with Genito-Urinary System Diseases	9	18	5	11	19	23	6	11
Per cent of total	6.5	11.7	3.6	7.2	14.1	9.8	4.5	4.7
Total number of patients	139	154	139	154	135	234	135	234

* Classification according to Internation Classification of Diseases, 8th Revision, 1965:

Diseases	I.C.D.List No.
Nephritis and Nethrosis	580-584
Urinary Tract Infections (N.O.C.): Diagnosis was based on the presence of bacteruria and accompanying clinical manifestations	
Other diseases of Urinary System	590-599
Diseases of Male Genital Organs	600-607
Diseases of Breast, Ovary, Fallopian Tube and parametrium	610-616
Diseases of Uterus and other Female Genital Organs	620-629
Delivery without mention of complications	650
Complications of Pregnancy, Childbirth and Puerperium	630-645 651-662 670-678

Table 28 : Cerebro-Vascular Diseases among 662 newly diagnosed diabetics at time of diagnosis and at end of observation period, according to sex and age groups

Cerebro-Vascular Diseases*	MALES				FEMALES			
	First Attend.		End of Period		First Attend.		End of Period	
	<60	60+	<60	60+	<60	60+	<60	60+
Cerebro-Vascular Accident	1	4	2	8	4	7	4	17
Other forms of Cerebro-Vascular Disease	1	2	2	5	0	2	1	3
Number of patients with Cerebro-Vascular Diseases	2	6	4	13	4	9	5	20
Per cent of total	1.4	3.9	2.9	8.5	3.0	3.9	3.7	8.6
Total number of Patients	139	154	139	154	135	234	135	234

*Classifications according to International Classification of Diseases, 8th Revision, 1965:

Diseases	I.C.D.List No.
Cerebro-Vascular Accidents	431, 433, 434
Other forms of Cerebro-Vascular Diseases	430, 432, 435-438

Table 29: Diseases of Nervous System, Sensory Organs and Mental Disorders, among 662 newly diagnosed diabetics at time of diagnosis and end of observation period, according to sex and age groups.

Diseases of Nervous System, Sensory Organs and Mental Disorders*	MALES				FEMALES			
	First Attend.		End of Period		First Attend.		End of Period	
	<60	60+	<60	60+	<60	60+	<60	60+
Inflammatory disease of C.N.S.	1	0	0	1	0	0	0	0
Other disease of C.N.S.	1	4	1	3	0	3	0	3
Dis. of nerves and peripheral ganglia	0	1	0	1	1	3	1	3
Inflammatory dis. of eye	0	0	0	0	0	2	0	1
Other dis. & condition of eye	2	1	2	1	2	9	2	9
Dis. of ear and mastoid process	1	0	1	0	0	0	0	0
Psychosis	3	2	3	3	3	6	3	6
Neurosis, personality disorders & other non-psychotic disorders	0	2	0	2	2	0	3	0
Mental retardation	1	0	1	0	1	0	1	0
Number of patients with nervous system disorders	7	11	7	11	9	22	10	21
Per cent of total	5.0	7.2	5.0	7.2	6.7	9.4	7.4	9.0
Total number of patients	139	154	139	154	135	234	135	234

* Classified according to International Classification of Diseases, 8th Revision, 1965:

Diseases	I.C.D.List No.
Inflammatory disease of C.N.S.	320-324
Other diseases of C.N.S.	330-333, 340-349
Diseases of Nerves and Peripheral Ganglia	350-358
Inflammatory diseases of the Eye	370-379
Diseases of Ear and Mastoid Process	380-389
Psychosis	290-299
Neurosis, Personality Disorders and other non-psychotic mental disorders	300-309
Mental Retardation	310-315

Table 30: Arthritis, Rheumatism and diseases of Musculo-Skeletal System among 662 newly diagnosed diabetics at time of diagnosis and at the end of observation period, according to sex and age groups.

Arthritis, Rheumatism and diseases of Musculo-Skeletal System*	MALES				FEMALES			
	First Attend.		End of Period		First Attend.		End of Period	
	<60	60+	<60	60+	<60	60+	<60	60+
Acute arthritis	1	0	0	0	0	0	0	0
Rheumatoid arthritis and allied conditions	0	0	0	0	2	15	2	15
Osteoarthritis and allied conditions	0	6	0	7	2	19	2	19
Other forms of arthritis and rheumatism	1	0	1	0	0	0	0	0
Osteomyelitis and other dis.of bone and joints	1	1	1	1	0	0	0	0
Other dis. of musculo-skeletal system	0	0	0	0	0	2	0	2
Number of patients with arthritis & rheumatism	3	7	2	8	4	36	4	36
Percent of total	2.2	4.6	1.4	5.2	3.0	15.4	3.0	15.4
Total number of patients	139	154	139	154	135	234	135	234

* Classification according to International Classification of Diseases, 8th Revision, 1965:

Diseases	I.C.D.List No.
Acute Arthritis	710, 711
Rheumatoid Arthritis and Allied Conditions	712
Osteoarthritis and Allied Conditions	713
Other forms of Arthritis and Rheumatism	714-718
Osteomyelitis & other diseases of Bone and Joints	720-729
Other diseases of Musculo-Skeletal System	730-738

Table 31: Neoplasms present among 662 newly diagnosed diabetics at time of diagnosis and end of observation period, according to sex and age groups.

Neoplasms Present Among Newly Diagnosed Diabetics*	MALES				FEMALES			
	First Attend.		End of Period		First Attend.		End of Period	
	<60	60+	<60	60+	<60	60+	<60	60+
Malig.Neoplasm of digestive system	0	2	1	2	0	1	0	3
Malig.Neoplasm of Pancreas	0	3	0	3	1	2	1	3
" " " respiratory system	0	1	0	3	0	1	0	1
Malig.Neoplasm,of Bone, connective tissue, skin & breast	0	1	0	1	3	4	4	6
Malig.Neoplasm of Genito-Urinary Organs	0	0	0	0	0	6	0	7
Neoplasms of Lymphatic and Haemopoetic tissues	0	2	0	2	0	1	0	1
Malig. Neoplasms of other and unspecified sites	0	1	0	1	0	0	0	0
Benign and unspecific nature neoplasms	0	0	0	0	0	1	0	1
Number of patients with Neoplasms	0	10	1	12	4	15	5	21
Per cent of total	-	6.5	0.7	7.8	3.0	6.4	3.7	9.0
Total number of patients	139	154	139	154	135	234	135	234

*Classification according to International Classification of Diseases, 8th Revision, 1965:

Disease	I.C.D.List No.
Malignant Neoplasms of digestive organs	150-156, 158-159
" " " pancreas	157
" " " respiratory organs	160-163
" " " bone, connective tissue, skin and breast	170-174
" " " genito-urinary organs	180-189
" " " lymphatic and haematopoetic tissue	200-209
" " " other and unspecified sites	190-199
Benign and unspecific nature neoplasms	210-228, 230-239

Table 32: Status of 775 patients at the end of 1-4 years follow-up according to method of first referral of patients to the Diabetic Department.

Status at end of observation period	Outpatients		Inpatients		G.T.T.		Total		Outpatients		Inpatients		G.T.T.		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
	"NO DURATION"								"DURATION"							
	MALES								MALES							
Alive	166	84.3	30	78.9	56	87.5	252	84.3	40	88.9	5	100.0	1	100.0	46	90.2
Defaulted	4	2.0	0	-	2	3.1	6	2.0	0	-	0	-	-	-	0	-
Dead	27	13.7	8	21.1	6	9.4	41	13.7	5	11.1	0	-	-	-	5	9.8
Total	197	100.0	38	100.0	64	100.0	299	100.0	45	100.0	5	100.0	1	100.0	51	100.0
	FEMALES								FEMALES							
Alive	239	88.9	47	87.0	43	86.0	329	88.2	37	84.1	5	62.5	0	-	42	80.8
Defaulted	3	1.1	0	-	1	2.0	4	1.1	0	-	0	-	0	-	0	-
Dead	27	10.0	7	13.0	6	12.0	40	10.7	7	15.9	3	37.5	0	-	10	19.2
Total	269	100.0	54	100.0	50	100.0	373	100.0	44	100.0	8	100.0	0	-	52	100.0

Table 33: The primary cause of death in 96 dead patients, according to sex and duration of diabetes from diagnosis till death.

The primary cause of death	DURATION OF DIABETES < 1 year	1-2 years	2-3 years	3+ years	Total No.	%
	M A L E S					
Diabetes Mellitus	0	0	0	0	0	-
Diabetes complications	0	0	0	0	0	-
Hypertension & hypertensive diseases	0	0	0	0	0	-
Acute myocardial infarction	4	6	2	7	19	41.3
Cardiac failure	1	1	0	1	3	6.5
Other cardiovascular causes	0	0	0	0	0	-
Cerebro-vascular accident	2	2	1	1	6	13.1
Pneumonia	2	2	2	1	7	15.2
Neoplasms	3	1	1	0	5	10.8
Other causes	1	3	2	0	6	13.1
Total	13	15	8	10	46	100
	F E M A L E S					
Diabetes Mellitus	0	1	0	1	2	4.0
Diabetes complications	0	0	0	2	2	4.0
Hypertension & hypertensive diseases	0	0	0	0	0	-
Acute myocardial infarction	5	3	1	1	10	20.0
Cardiac failure	1	0	1	1	3	6.0
Other cardiovascular causes	0	3	1	1	5	10.0
Cerebro-vascular accident	0	3	1	4	8	16.0
Pneumonia	1	5	1	3	10	20.0
Neoplasms	3	5	0	2	10	20.0
Other causes	0	0	0	0	0	-
Total	10	20	5	15	50	100

Table34 : Number (per cent) of 387 newly diagnosed patients distributed according to number of attendances in the second year.

Age at Diagnosis	Number of attendances in second year					
	Nil	1-2	3-4	5+	Total	
					Per cent	Number
	MALES					
< 20	8.3	41.7	25.0	25.0	100.0	12
20 - 39	20.0	60.0	5.0	15.0	100.0	20
40 - 59	18.0	64.0	12.0	6.0	100.0	50
60 - 79	19.0	62.1	14.7	4.2	100.0	95
80+	28.6	57.1	14.3	-	100.0	7
Total	18.5	60.9	13.6	7.1	100.1	184
	FEMALES					
< 20	-	28.6	42.9	28.6	100.1	7
20 - 39	15.4	38.5	23.1	23.1	100.1	13
40 - 59	22.0	54.2	20.3	3.4	99.9	59
60 - 79	15.0	56.6	23.9	4.4	99.9	113
80+	18.2	81.8	-	-	100.0	11
Total	16.8	55.2	22.2	5.9	100.1	203

Table 35 : Number (per cent) of 167 newly diagnosed patients distributed according to number of attendances in the third year.

Age at Diagnosis	Number of attendances in third year					
	Nil	1-2	3-4	5+	Total	
					Per cent	Number
	M A L E S					
<20	20.0	20.0	20.0	40.0	100.0	5
20 - 39	9.1	72.7	9.1	9.1	100.0	11
40 - 59	-	94.4	-	5.6	100.0	18
60 - 79	15.6	71.1	11.1	2.2	100.0	45
80+	25.0	75.0	-	-	100.0	4
Total	12.1	73.5	8.4	6.0	100.0	83
	F E M A L E S					
<20	-	-	100.0	-	100.0	2
20 - 39	-	60.0	20.0	20.0	100.0	5
40 - 59	13.0	65.2	4.4	17.4	100.0	23
60 - 79	13.7	68.6	15.7	2.0	100.0	51
80+	33.3	66.7	-	-	100.0	3
Total	13.1	65.5	14.3	7.1	100.0	84

Table 36: Number (per cent) of 662 patients in each economic position group, distributed according to number of attendances.

Number of Attendances	Economically Active	Economically Inactive	Unknown
M A L E S			
1 - 2	32.2	37.4	-
3+	67.8	62.6	100.0
Number of patients	100.0 (171)	100.0 (107)	100.0 (15)
F E M A L E S			
1 - 2	14.6	29.7	41.2
3+	85.4	70.3	58.8
Number of patients	100.0 (82)	100.0 (236	100.0 (51)

Table 37: Marital status and number of attendances in the first year(percentage for 662 newly diagnosed diabetics)

Number of attendances	Married	Others*	Unknown
	MALES		
1 - 2	32.3	34.9	23.8
3+	67.7	65.1	76.2
Number of patients	186 (100)	86 (100)	21 (100)
	FEMALES		
1 - 2	25.3	28.5	42.1
3+	74.7	71.5	57.9
Number of patients	178 (100)	172 (100)	19 (100)

* Other = single, widowed and divorced.

Table 38: Number of patients admitted to hospital within one year of first attendance according to sex and age (103 "Duration" patients")

Age at diagnosis	MALES					FEMALES				
	Nil	1	2	3+	total	Nil	1	2	3+	Total
< 20	8	3	0	0	11	10	1	0	0	11
20 - 39	3	4	2	1	10	3	1	1	0	5
40 - 59	9	8	0	0	18	9	6	0	0	15
60 - 79	9	2	0	0	11	10	10	1	0	21
80+	0	1	0	0	1	0	0	0	0	0
All ages	29	18	3	1	51	32	18	2	0	52
Per cent	56.9	35.3	5.9	1.9	100.0	61.5	34.6	3.9	-	100.0

Table 39: Number of patients admitted to hospital in the second and third year following diagnosis (newly diagnosed patients)

Age at diagnosis	Nil	1	2	3+	Total Number of patients
Number of admissions in Second Year					
< 20	16	2	0	1	19
20 - 39	27	3	3	0	33
40 - 59	94	15	0	0	109
60 - 79	183	24	0	1	208
80+	15	3	0	0	18
All ages	335	47	3	2	387
Per cent	86.6	12.2	0.8	0.5	100.1
Number of admissions in Third Year					
< 20	5	2	0	0	7
20 - 39	12	4	0	0	16
40 - 59	36	4	1	0	41
60 - 79	83	12	1	0	96
80+	6	1	0	0	7
All ages	142	23	2	0	167
Per cent	85.0	13.8	1.2	-	100.0

Table 40 : Number of patients and mean duration of stay in second year (per diabetic and per diabetic admitted)

AGE	Total patients	Mean duration per diabetic	Number admitted	Mean duration per diabetic admitted
	M A L E S			
< 20	12	4.3	2	26.0
20 - 39	20	4.7	4	23.3
40 - 59	50	2.9	4	36.3
60 - 79	95	2.7	12	21.4
80+	7	8.0	1	56.0
All ages	184	3.3	23	26.2
AGE	F E M A L E S			
< 20	7	6.0	1	42.0
20 - 39	13	2.1	2	13.5
40 - 59	59	4.1	11	21.8
60 - 79	113	2.2	13	19.4
80+	11	5.4	2	29.5
All ages	203	3.1	29	21.4

Table 41 : Number of patients and mean duration of stay in third year (per diabetic and per diabetic admitted)

AGE	Total patients	Mean duration per diabetic	Number admitted	Mean duration per diabetic admitted
	MALES			
< 20	5	2.0	1	10.0
20 - 39	11	1.4	3	5.0
40 - 59	18	3.4	2	30.5
60 - 79	45	2.0	6	14.8
80+	4	-	0	-
All ages	83	2.1	12	14.6
AGE	FEMALES			
< 20	2	5.0	1	10.0
20 - 39	5	2.0	1	10.0
40 - 59	23	2.2	3	17.0
60 - 79	51	3.0	7	22.0
80+	3	3.3	1	10.0
All ages	84	2.8	13	18.2

Table 42 : Admission to hospital according to source of referrals

Period in hospital in first year	"Outpatients"		"Inpatients"		"G.T.T."	
	No.	%	No.	%	No.	%
	MALES					
≤ 2 weeks	43	59.7	12	31.6	10	62.5
> 2 weeks	29	40.3	26	68.4	6	37.5
Number admitted	72	100.0	38	100.0	16	100.0
Percentage of total	37.3	-	100.0	-	25.8	-
Total No. of patients	193	-	38	-	62	-
	FEMALES					
≤ 2 weeks	53	54.6	12	22.2	4	26.7
> 2 weeks	44	45.4	42	77.8	11	73.3
Number admitted	97	100.0	54	100.0	15	100.0
Percentage of total	36.5	-	100.0	-	30.6	-
Total No. of patients	266	-	54	-	49	-

Table 43: Admission to hospital and status of patients at end of observation period

Period in hospital in first year	MALES				FEMALES			
	Alive		Dead		Alive		Dead	
	No.	%	No.	%	No.	%	No.	%
< 2 weeks	55	57.3	10	33.3	66	45.5	3	14.3
> 2 weeks	41	42.7	20	66.7	79	54.5	18	85.7
Number admitted	96	100.0	30	100.0	145	100.0	21	100.0
Per cent of total	38.1		73.2		44.1		52.5	
Total No. of patients	252		41		329		40	

Table 44: Admission to hospital and the economic position of patients

Period in hospital in first year	MALES					
	Economically active		Economically inactive		Unknown	
	No.	%	No.	%	No.	%
< 2 weeks	41	59.4	23	41.8	1	50.0
> 2 weeks	28	40.6	32	58.2	1	50.0
No. admitted	69	100.0	55	100.0	2	100.0
Per cent of total	40.4		51.4		13.3	
Total number	171		107		15	
	FEMALES					
< 2 weeks	26	66.7	37	34.9	8	38.1
> 2 weeks	13	33.3	69	65.1	13	61.9
No. admitted	39	100.0	106	100.0	21	100.0
Per cent of total	47.6		44.9		41.2	
Total number	82		236		51	

Table 45: Admission to hospital and marital status

Period in hospital in first year	MALES					
	Married		Others*		Unknown	
	No.	%	No.	%	No.	%
< 2 weeks	31	44.9	32	58.2	1	50.0
> 2 weeks	38	55.1	23	41.8	1	50.0
No.admitted	69	100.0	55	100.0	2	100.0
Per cent of total	37.1		64.0		9.5	
Total number	186		86		21	
	FEMALES					
< 2 weeks	26	41.9	39	39.8	2	33.3
> 2 weeks	36	58.1	59	60.2	4	66.7
No.admitted	62	100.0	98	100.0	6	100.0
Per cent of total	34.8		57.0		31.6	
Total number	178		172		19	

* Others : marital status : single, widowed and divorced.

Table 46: "Home-bed" disability according to type of diabetes

Home-bed disability	Insulin-dependent		Insulin-independent	
	No.	%	No.	%
≤ 2 weeks	3	50.0	10	25.6
More than 2 weeks	3	50.0	29	74.4
Patients with home disability	6	100.0	39	100.0
Per cent of total number	18.2	-	21.3	-
Total number of patients	33	-	183	-

Table 47: "Home-bed" diaability according to weight of patients

Home bed disability period	Normal and under weight		Overweight (more than 10% of standard weight	
	No.	%	No.	%
$\leqslant$ 2 weeks	11	42.3	2	10.5
More than 2 weeks	15	57.7	17	89.5
Patients with bed disability	26	100.0	19	100.0
Per cent of total	19.7	-	22.9	-
Total number of patients	132*	-	83*	-

* The weight of one woman was not known

Table 48: Economic position and bed diaability period at home

Home-bed disability period	Economically active		Economically inactive	
	No.	%	No.	%
≤ 2 weeks	5	41.7	8	24.2
More than 2 weeks	7	58.3	25	75.8
Patients with bed disability	12	100.0	33	100.0
Per cent of total	13.6	-	25.8	-
Total number of patients	88	-	128	-

Table 49 : Home-bed diaability period according to marital status

Home-bed disability period	MALES				FEMALES			
	Married		"Other"		Married		"Other"	
	No.	%	No.	%	No.	%	No.	%
< 2 weeks	3	21.4	0	-	4	25.0	6	40.0
More than 2 weeks	11	78.6	0	-	12	75.0	9	60.0
Patients with bed disab.	14	100.0	0	-	16	100.0	15	100.0
Per cent of total	22.6	-	-	-	22.9	-	22.7	-
Total No. of patients	62	-	18	-	70	-	66	-

Table 50 : Distribution of patients with work loss, according to their occupation

Period of work loss	Manual		Non-Manual	
	No.	%	No.	%
$\leq$ 2 weeks	1	7.1	9	29.0
more than 2 weeks	13	92.9	22	71.0
number of patients with work load loss	14	100.0	31	100.0
Per cent of total	48.3	-	62.0	-
Total No. of patients	29	-	50	-

Table 51 : Distribution of patients with work loss, according to type of diabetes

Period of work loss	Insulin-Dependent		Insulin-Independent	
	No.	%	No.	%
$\leq$ 2 weeks	7	41.2	8	28.6
More than 2 weeks	10	58.8	20	71.4
Number of patients with work loss	17	100.0	28	100.0
Per cent of total	85.0	-	47.5	-
Total number of patients	20	-	59	-

Table 52: Distribution of patients with activity restriction, according to economic position

Period of restricted activity	MALES				FEMALES			
	Economically active		Economically inactive		Economically active		Economically inactive	
	No.	%	No.	%	No.	%	No.	%
< 2 weeks	10	30.3	5	22.7	5	27.8	17	20.7
More than 2 weeks	23	69.7	17	77.3	13	72.2	65	79.3
Patients with restricted activity	33	100.0	22	100.0	18	100.0	82	100.0
Per cent of total	57.9	-	95.7	-	58.1	-	78.1	-
Total number of patients	57	-	23	-	31	-	105	-

Table 53: Distribution of patients with activity restriction according to social class

Period of restricted activity	SOCIAL CLASS					
	I & II		III		IV & V	
	No.	%	No.	%	No.	%
< 2 weeks	5	15.6	26	31.3	7	17.5
More than 2 weeks	27	84.4	57	68.7	33	82.5
Patients with restricted activity	32	100.0	83	100.0	40	100.0
Per cent of total	66.7	-	70.9	-	78.4	-
Total number of patients	48	-	117	-	51	-

Table 54: Number of newly diagnosed patients with unrecorded admissions, their percentage out of those with admission, and their mean duration of stay.

AGE	Total Number of patient	Number Admitted	Patient with Unrecorded admission		Mean duration of stay not recorded
			Number	Percent of those admitted	
MALES					
< 20	9	9	2	22.2	12.5
20 - 39	6	4	1	25.0	6.0
40 - 59	39	16	6	37.5	13.3
60 - 79	25	12	4	33.3	30.0
80+	1	1	0	-	-
All ages	80	42	13	31.0	17.7
FEMALES					
< 20	8	8	1	12.5	9.0
20 - 39	7	6	1	16.7	14.0
40 - 59	36	16	6	37.5	24.2
60 - 79	80	35	18	51.4	24.2
80+	5	4	1	25.0	58.0
All ages	136	69	27	39.1	24.5

Table 55: Causes of admission in newly diagnosed patients with unrecorded admissions according to duration of stay in hospital.

Principle cause of admission	< two weeks	2 - 4 weeks	4 or more weeks	Total No.	%
Diabetes mellitus	0	2	1	3	7.5
Cardiovascular Diseases	3	0	4	7	17.5
Respiratory Dis.	1	0	3	4	10.0
Digestive Dis.	3	1	0	4	10.0
Genito-Urinary Diseases.	2	4	3	9	22.5
Cataract	2	2	1	5	12.5
Others	4	2	2	8	20.0
Total number of patients	15	11	14	40	100.0

Table 56: Unrecorded variables and type of Diabetes

Unrecorded Variables	MALES		FEMALES	
	Insulin-Dependent	Insulin-Independent	Insulin-Dependent	Insulin-Independent
Marital Status	5	37	2	32
Occupation	10	28	13	107
Chronic disease	0	6	0	11
Hospital Admission	2	12	5	24
None	10	22	14	12
Percent recorded	45.5	29.7	51.9	9.5
Number of Patients	22	74	27	126

Table 57: Unrecorded variables according to economic position.

Unrecorded Variable	MALES		FEMALES	
	Economically active	Economically inactive	Economically active	Economically inactive
Marital status	32	10	6	28
Occupation	16	22	14	106
Chronic disease	4	2	2	9
Hospital Admission	5	9	4	25
None	27	5	21	5
Percent recorded	40.3	17.3	56.8	4.3
Number of Patients	67	29	37	116

Table 58: Unrecorded Variables and Marital Status.

Unrecorded variables	MALES		FEMALES	
	Married	"Other"*	Married	"Other"*
Marital status	34	8	17	17
Occupation	25	13	60	60
Chronic disease	5	1	3	8
Hospital Admission	6	8	6	23
None	26	6	12	14
Percent recorded	35.6	26.1	15.8	18.2
Number of Patients	73	23	76	77

* "other" includes: single, widow and Divorced.

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